INDIA RUBBER WORLD

OUR 65th YEAR

A BILL BROTHERS PUBLICATION

MAY, 1954

PUBLIC LIBRARY

Throughout the world . . . in GR-S and Natural Rubber

***Increased Tire Mileage** with*

CABOT ***Vulcan 6*** *(ISAF)*

Intermediate Super Abrasion Oil Furnace Carbon Black

Godfrey L. Cabot, Inc., Boston

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Neoprene Type W

Reduces Summer Processing Problems

Hot weather is coming—If you have had processing difficulties with Neoprene Type GN compounds, blend in some Type W, or use all Type W—as many of our customers do. As little as 25% Type W in a Type GN compound will increase compounded and uncompounded stiffness with no appreciable change in cured physical properties. Scorchiness is also reduced.

Beat summer to the gun. Solve your problems before they appear. Use Type W or GN/W blends.

TYPICAL PROPERTIES OF NEOPRENE TYPE GN/W BLENDS

Compound	A	B	C	D
Neoprene Type GN	100	75	50	—
Neoprene Type W	–	25	50	100
Stearic Acid	0.5	0.5	0.5	0.5
Neozone* A	2	2	2	2
Magnesia	4	4	4	4
SRF Carbon Black	29	29	29	29
Zinc Oxide	5	5	5	5
Thionex*	–	–	–	0.5
DOTG	–	–	–	0.5
Sulfur	–	–	–	1.0
Polymer Viscosity				
Millability @ 121°F	Sticky	Good	Good	Good
Mooney Viscosity @ 212°F				
Original ML 2½	62	–	–	47
ML 2½ after 5′ mill	33	38	42	46

Compound Viscosity	A	B	C	D
Mooney Viscosity @ 212°F	21	22	25	28
Mooney Scorch @ 250° (min to 10 pt vise)	31	44	44	45+
Physical Properties (Cured 20′ 307°F)				
Tensile Strength, psi	3075	3075	3175	3500
Stress @ 300% Elongation	1225	1275	1125	1150
Elongation at break %	800	740	800	700
Durometer Hardness	60	60	59	54
Compression Set Cure 25′/307°F				
22 hours/158°F	38	34	31	11
70 hours/212°F	87	85	77	63

*TRADE-MARK REG. U. S. PAT. OFF.

DISTRICT OFFICES:

Akron 8, Ohio, 40 E Buchtel Ave ....POrtage 2-8461
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DU PONT RUBBER CHEMICALS

DU PONT
REG. U.S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

India Rubber World, May, 1954, Vol. 130, No. 2. Published monthly by Bill Brothers Publishing Corp. Office of Publication, 1309 Noble Street, Philadelphia, Pa., with Editorial and Executive Offices at 386 Fourth Avenue, New York 16, N. Y., U.S.A. Entered as Second Class Matter at the Post Office at Philadelphia, Pa., under the act of March 3, 1879. Subscription United States and Mexico, $5.00 per year; Canada, $6.00; All other Countries $7.00; Single Copies 50 cents. Address Mail to N. Y. Office.

News about

B. F. Goodrich Chemical *raw materials*

RUBBER compounders find many processing advantages with Good-rite Vultrol. It prevents scorching the year 'round . . . retards scorch at processing temperatures and also acts as a mild activator at curing temperatures.

MORE ADVANTAGES → Good-rite Vultrol is beneficial on highly-loaded or highly-accelerated compounds. It is particularly effective with high abrasion furnace blacks. Vultrol permits uninterrupted production, reduces "dead" stocks, requires no special handling.

Supplied as a free-flowing flake, Good-rite Vultrol is economical and easy to use—saves time, money and labor. For information, please write Dept. HA-5, B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

B. F. Goodrich Chemical Company
A Division of The B. F. Goodrich Company

Good-rite *Rubber Chemicals*

GEON polyvinyl materials • HYCAR American rubber • GOOD-RITE chemicals and plasticizers • HARMON colors

Philblack pellets

We devote much effort to serving up your Philblack* in proper "pelleted" form.

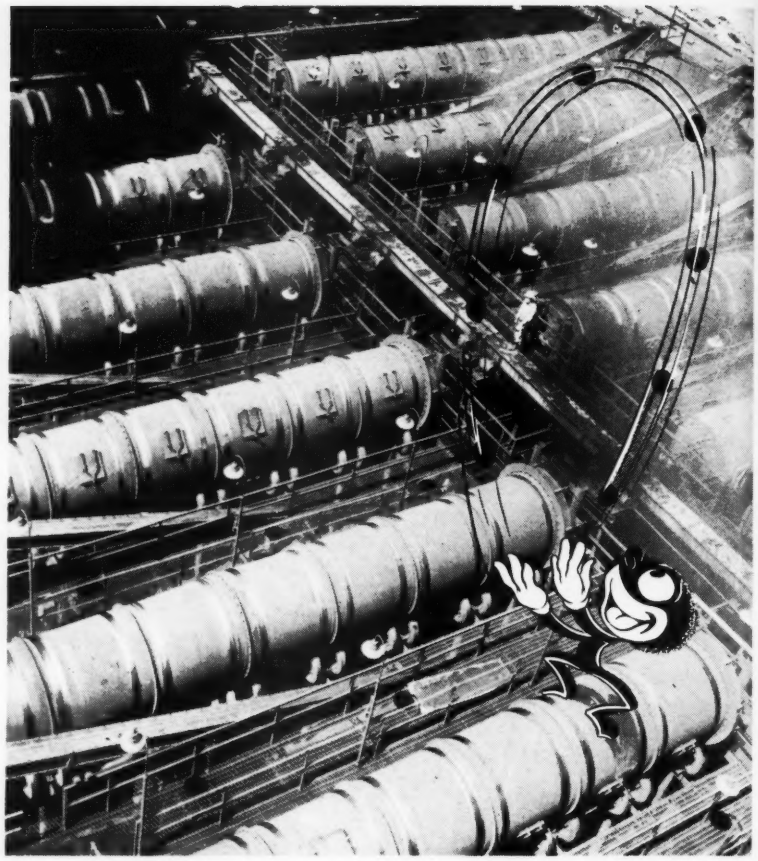
Initially, Philblack is a light fluffy material. It weighs only 3 pounds per cubic foot. Our pellet mills concentrate this to a density near 23 pounds per cubic foot.

The resulting pellets are about 1/32 of an inch or less in diameter and generally spherical in shape. We aim to have most Philblack pellets in the range of 20 to 65 U. S. sieve mesh. This induces efficient unloading of hopper cars and bags and cuts down the dust nuisance, too.

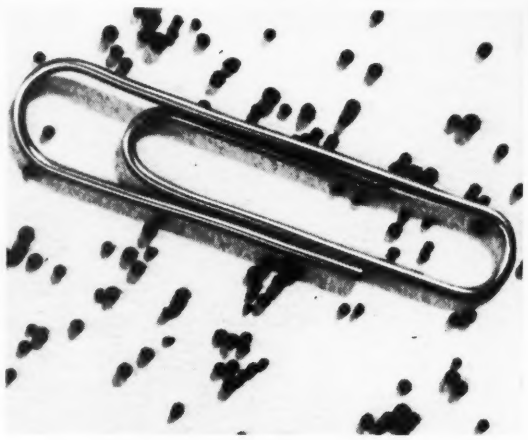
Actual operation of the pellet mills is pretty much an empirical art which is yielding gradually to mathematical analysis. Our modern pelleting methods are designed to produce free-flowing Philblack pellets which withstand bulk handling and yet incorporate rapidly and efficiently in your Banbury mixers.

We are particularly interested in helping Philblack customers and prospective customers with problems involving carbon black and rubber. Our Sales-Service Laboratory may well have a solution for one of your current worries. So, get in touch with our technical representative. Or write: Phillips Chemical Company, 318 Water Street, Akron 8, Ohio.

*A TRADEMARK



Rotary pellet mills at Borger, Texas, Philblack plant, the world's largest furnace black plant.



Philblack pellets... (shown with 1 ¼-inch paper clip for comparison of size.) Note uniformity and absence of grit in this unretouched sample.

Know the Philblacks! KNOW WHAT THEY'LL DO FOR YOU!

A **Philblack A FEF Fast Extrusion Furnace**
Ideal for smooth tubing, accurate molding, satiny finish. Mixes easily. High, hot tensile. Disperses heat. Non-staining.

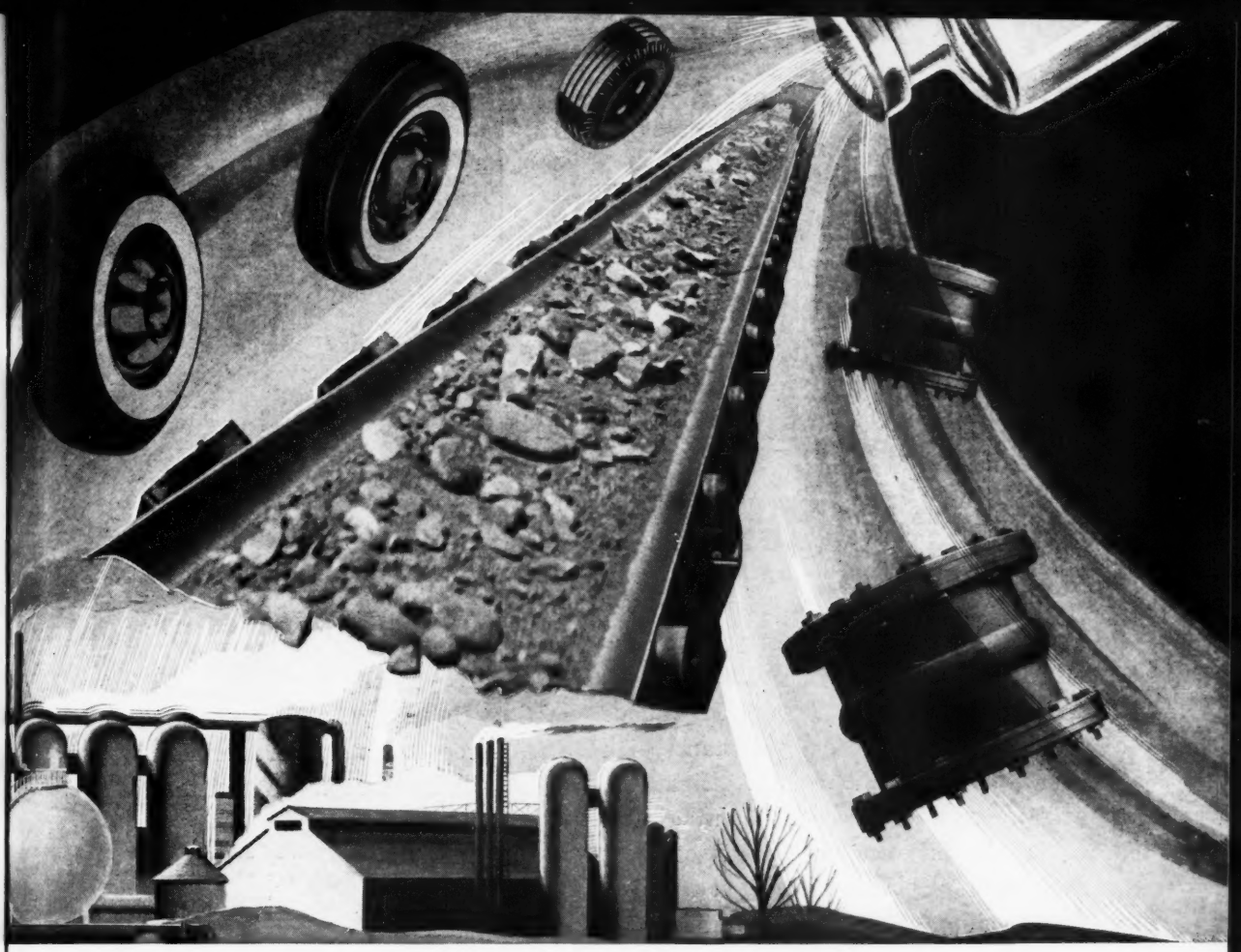
O **Philblack O HAF High Abrasion Furnace**
For long, durable life. Good electrical conductivity. Excellent flex. Fine dispersion.

I **Philblack I ISAF Intermediate Super Abrasion Furnace**
Superior abrasion resistance at moderate cost. Very high resistance to cuts and cracks. More tread miles at high speeds.

E **Philblack E SAF Super Abrasion Furnace**
Toughest black on the market. Extreme abrasion resistance. Withstands aging, cracking, cutting and chipping.

Phillips 66

PHILLIPS CHEMICAL COMPANY, Philblack Sales, 318 Water Street, Akron 8, Ohio. Export Sales: 80 Broadway, New York 5, N. Y. West Coast: Harwick Standard Chemical Company, Los Angeles, California. Canada: H. L. Blachford, Ltd., Montreal and Toronto.



B-L-E® ends aging problems*

*oxygen attack • *heat breakdown • *flex-cracking

Whatever your rubber product—tires, transmission belting, conveyor belts, or other natural or synthetic goods—you'll appreciate the wide, outstanding protection B-L-E provides.

Used as a stabilizer for crude GR-S, or as an additive to protect your finished products, B-L-E is one of the most important tools in modern rubber compounding. A liquid, it disperses rapidly and uniformly in the compound.

B-L-E was one of the first antioxidants, introduced by Naugatuck in 1930. Continually improved since then, it *still* offers the finest and most up-to-date stabilization for crude GR-S, and anti-aging qualities for finished rubber goods.

Better try B-L-E. It will do your rubber products good.

50TH ANNIVERSARY 1904 NAUGATUCK 1954 NAUGATUCK CHEMICAL

Naugatuck Chemical

Division of United States Rubber Company

135 ELM STREET, NAUGATUCK, CONNECTICUT

IN CANADA: NAUGATUCK CHEMICALS DIVISION • Dominion Rubber Company, Limited, Elmira, Ontario

RUBBER CHEMICALS • SYNTHETIC RUBBER • PLASTICS • AGRICULTURAL CHEMICALS • RECLAIMED RUBBER • LATICES

NEWS FOR NEOPRENE* USERS-

you get true reinforcement with new Plio-Tuf

PLIO-TUF is the newest high styrene copolymer to come from the laboratories of the Goodyear Chemical Division. Its unique combination of high impact resistance, high heat distortion point, hardness, lightness, stiffness and abrasion, chemical and electrical resistance has made it of great interest to the plastic industry as an injection molding, extrusion and post-forming resin.

Now, new evaluations make it of equal interest to the rubber industry. It has been found that PLIO-TUF reinforces all types of rubber, particularly Neoprene. Yes, for the first time, here is a resin that truly reinforces Neoprene to open entirely new fields of application.

PLIO-TUF is completely compatible with Neoprene. Low PLIO-TUF/high Neoprene stocks display excellent flex life and abrasion resistance, stiffness, high hardness as well as high modulus, low permanent set and exceptionally good aging properties. High PLIO-TUF/low Neoprene blends display proportionately more resinous properties with excellent impact resistance as the outstanding advantage.

The low PLIO-TUF/high Neoprene stocks are of particular interest, since they combine the particular properties of Neoprene with the already established advantages of other rubber-resin blends. Important, too, are the facts that these new combinations process and cure in the conventional manner on existent equipment.

Why not probe the possibilities of PLIO-TUF /Neoprene blends in your laboratory? A note or post card will bring generous samples and full technical help, promptly and without obligation. Just write to:

Goodyear, Chemical Division
Akron 16, Ohio

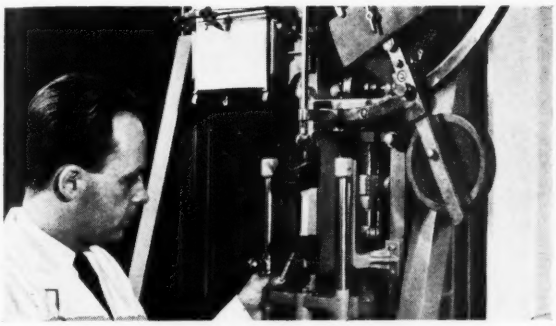
CHEMICAL GOODYEAR DIVISION

*Neoprene—T.M. E. I. Du Pont de Nemours Company

Chemigum, Pliobond, Pliolite, Plio-Tuf, Pliovic—T. M.'s The Goodyear Tire & Rubber Company, Akron, Ohio

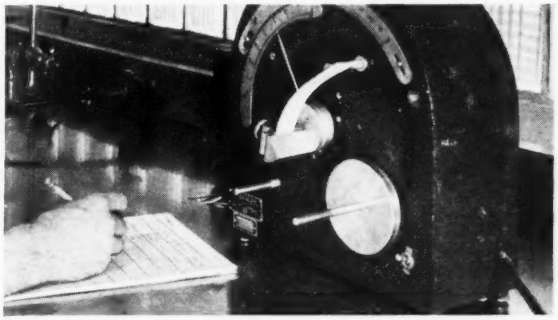
Use-Proved Products — CHEMIGUM • PLIOBOND • PLIOLITE • PLIO-TUF • PLIOVIC • WING-CHEMICALS — The Finest Chemicals for Industry

Just look what **Plio-Tuf** does for Neoprene:

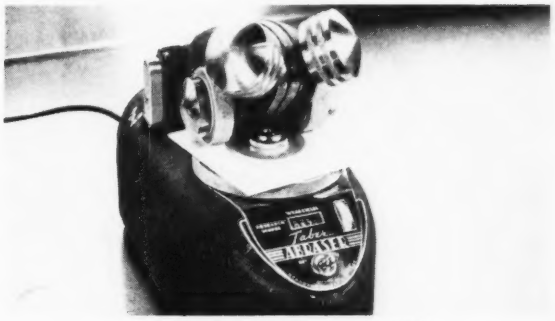


TENSILE STRENGTH
20-80 pts. PLIO-TUF/100 pts. Neoprene = 1760-2150 psi

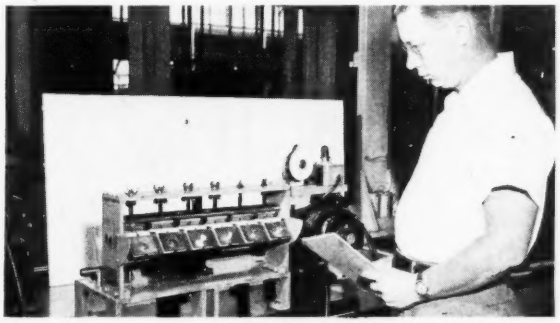
HARDNESS, SHORE A
20-80 pts. PLIO-TUF/100 pts. Neoprene = 60-96



STIFFNESS, OLSEN
20-80 pts. PLIO-TUF/100 pts. Neoprene = 551-6545 psi

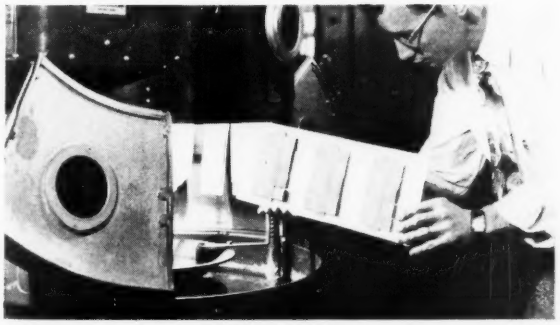


ABRASION, TABER, H-22 WHEEL
20-80 pts. PLIO-TUF/100 pts. Neoprene = 0.713-0.224 gms. loss

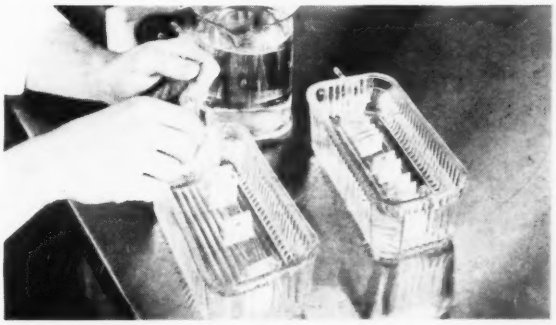


FLEX RESISTANCE, ROSS
20-80 pts. PLIO-TUF/100 pts. Neoprene = 202, 270
—1600 cycles for rating of 10

PERMANENT SET
20-80 pts. PLIO-TUF/100 pts. Neoprene = 14.05-55.50%



AGING, WEATHEROMETER, 96 HOURS
Considered exceptionally good over complete range of reinforcement



CHEMICAL RESISTANCE
Varies from good to excellent, depending upon resin content

NOTE: Four test compounds were used to obtain the above results. These consisted of 100 parts Neoprene, 4 parts MgO, 5 parts ZnO and 20, 40, 60 or 80 parts PLIO-TUF. All compounds were cured 30 minutes at 305° F.

look and **see**

If you look at the facts, you will see the advantages of specifying A. Gross & Company as your STEARIC ACID supplier.

Over the years, prior to the manufacture of hydrogenated Stearic Acids, A. Gross & Company supplied the rubber industry with Stearic Acids made by the "pressing" method.

Currently, A. Gross & Company offers a complete line of hydrogenated fatty acids of high quality and low prices, produced by A. Gross' "know how". For the rubber industry, we offer a Hydrogenated Rubber Grade Stearic Acid carrying the A. Gross guarantee of uniformity.

Our location in Newark, New Jersey, makes available to eastern consumers a ready source of supply for Hydrogenated Rubber Grade Stearic Acid. Nation-wide distribution points service others promptly.

HYDROGENATED RUBBER GRADE STEARIC ACID

Titre	54° C min.
Color	9 FAC min.
Saponification Value	200 - 204
Acid Value	195 - 200
Iodine Value	7 min.

A. GROSS & Company

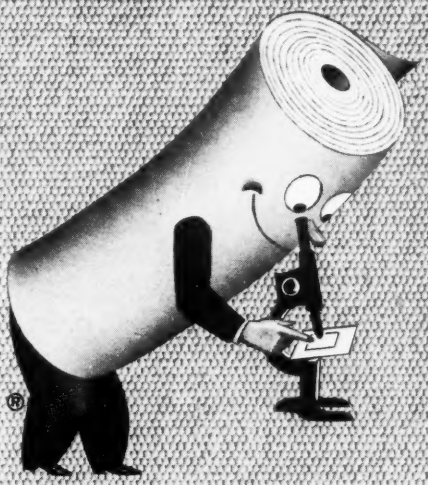
Manufacturers Since 1837

295 Madison Ave., New York 17, N. Y.
Factory, Newark, N. J. Distributors in Principal Cities

UNIFORMITY

Makes The Big Difference In

INDUSTRIAL FABRICS



MT. VERNON FABRICS

Give You Greater Uniformity

FABRICS ENGINEERED TO FIT YOUR NEEDS – Need adaptation of an existing fabric to your special purposes? Or creation of an entirely NEW fabric – cotton, synthetic or blend – to meet your specifications? Mt. Vernon-Woodberry's staff of textile engineers is available on request to help you with your problems in development or application of industrial fabrics.

Mt. Vernon-Woodberry Mills

TURNER HALSEY COMPANY
Selling Agents

Main Office: 40 Worth St. • New York

Branch Offices: Chicago • Atlanta • Baltimore • Boston • Los Angeles

One of a series of comprehensive laboratory controls throughout production to assure uniformity in all Mt. Vernon-Woodberry products. Here fabric thickness after weaving is being gauged.

Pequanoc

4460 RECLAIM

FOR NEUTRAL HEEL STOCK

Pequanoc 4460 reclaim *is widely used for neutral heels on tan or black shoes.*

NEUTRAL HEEL (A 336-19)

Amber Crepe	21.15	Hard Clay	17.50
PEQUANOC 4460 Reclaim	36.30	Frost Inhibitor	.13
Mineral Rubber	3.50	Process Oil	1.75
Zinc Oxide	1.30	Benzothiazyl Disulfide	.60
Stearic Acid	.60	D O T G	.13
Hi-Sil	16.00	Sulfur	1.04
			100.00

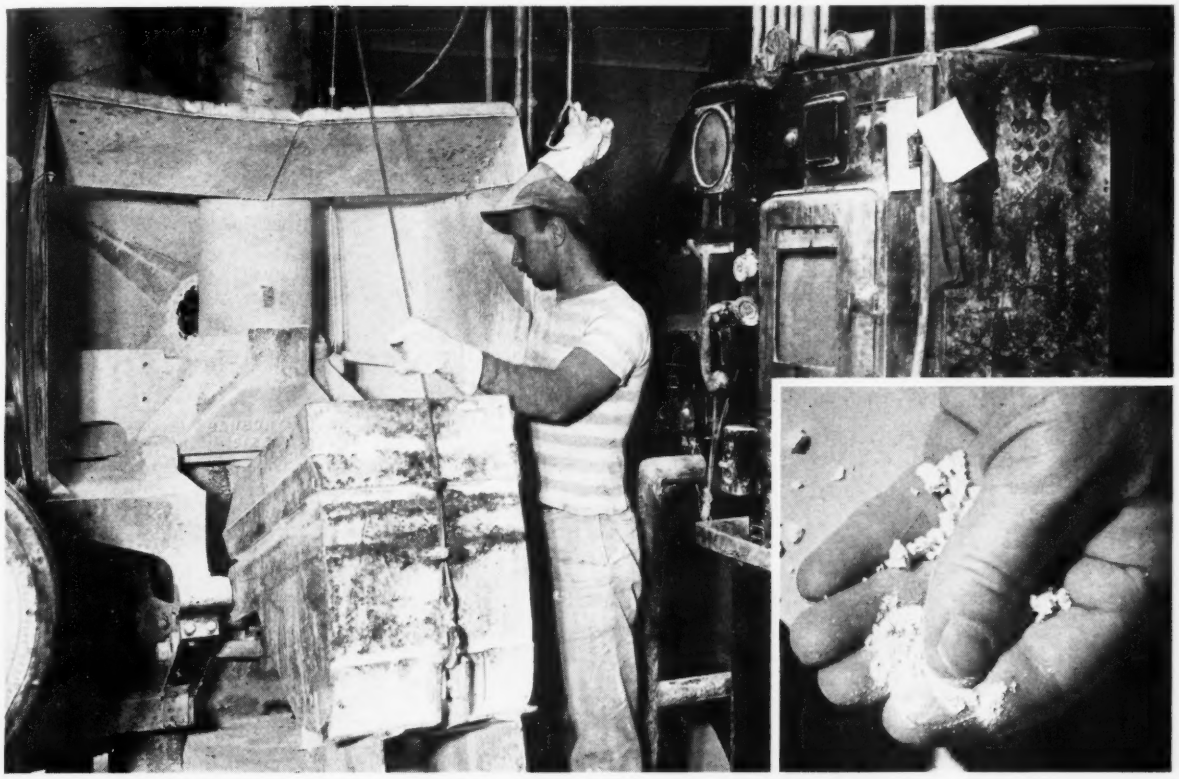
Est. Lb. Cost	.1130
Specific Gravity	1.37
Volume Cost	.1548
Cure	8 Minutes @ 324°F.
"A" Durometer	72-77
Bureau of Standards Abrasive Index	32-35

Pequanoc Rubber Co.

MANUFACTURERS OF RECLAIMED RUBBER

MAIN SALES OFFICE and FACTORY: BUTLER, N. J.

MUCH LESS FLY LOSS than pictured here is yours when you use easily friable (see inset), minimum dusting granules of PLIOLITE S-6B. More usable reinforcement per pound of resin, better working conditions, lower costs result.



SAVE RESIN—SAVE MONEY

on shoe sole stocks with granular PLIOLITE S-6B

PICTURED above is what your Banbury *won't* look like, if you use PLIOLITE S-6B—the *first* rubber-reinforcing, high styrene-butadiene copolymer to be supplied in easily friable, minimum dusting granules.

This granular form not only means less fly loss during mixing, but also permits maintenance of uniformity that results in a constant, higher bulk density. And this spells lower costs through smaller, more manageable bags and larger Banbury charges.

Moreover these granules quickly break down into a fine powder to give you an easier, faster, more thorough dispersion—more reinforcement per pound—and a better combination of shoe sole properties – than any other reinforcing resin. You can prove all this in your own laboratory with the generous samples and technical assistance that come from writing to:

Goodyear, Chemical Division, Akron 16, Ohio

CHEMICAL GOODYEAR DIVISION

Chemigum, Pliobond, Pliolite, Plio-Tuf, Pliovic—T. M.'s The Goodyear Tire & Rubber Company, Akron, Ohio

Use-Proved Products — CHEMIGUM • PLIOBOND • PLIOLITE • PLIO-TUF • PLIOVIC • WING-CHEMICALS — The Finest Chemicals for Industry

THE FIRST STEP IN A BANBURY

the KENNEDY *Fully Automatic*

If your Banburys are to be completely modern ...*don't leave this system out of your plans!*

Whatever the number and size of your Banburys or the number of carbon blacks you require, the Kennedy Carbon Black System can meet your needs dependably and economically. It is by far the most modern method for handling carbon blacks, yet is thoroughly tried and proven. The Kennedy Pneumatic Carbon Black System is not new . . . it has been in use for years as an integral part of the most advanced Banbury installations in the industry.

Years of research and development, extensive production facilities, and a large staff of qualified personnel stand back of every *Kennedy* installation.

If you are contemplating a modernization program for one or more of your Banburys . . . learn the facts about the Kennedy fully automatic Pneumatic Carbon Black System.

SIMPLE!

Basic equipment has no high speed moving parts to wear and require replacement. Blacks are conveyed through standard pipe transport lines which require no space-wasting structures.

AUTOMATIC!

A central electrical control unit operate the system without attention to meet any production demands. Several blacks can be handled without contamination through same transport line.

FLEXIBLE!

Any capacity—any number of blacks—any number of Banburys. Future expansion of system at minimum cost and least disturbance to existing plant.

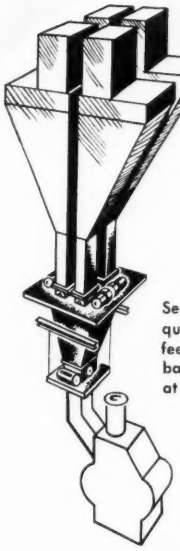
CLEAN!

System is completely enclosed from bulk car to Banbury. Vastly increases plant cleanliness—makes "good housekeeping" easier.

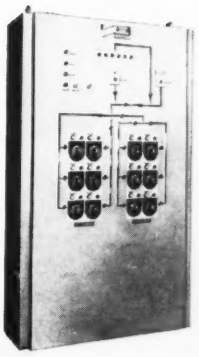
RYMODERNIZATION PROGRAM

...neumatic Carbon Black System...

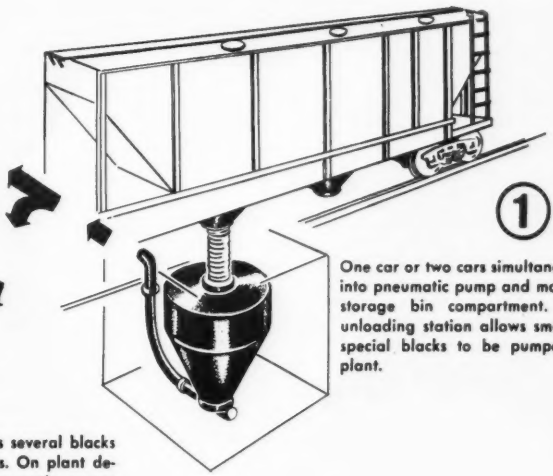
HERE'S HOW IT WORKS!



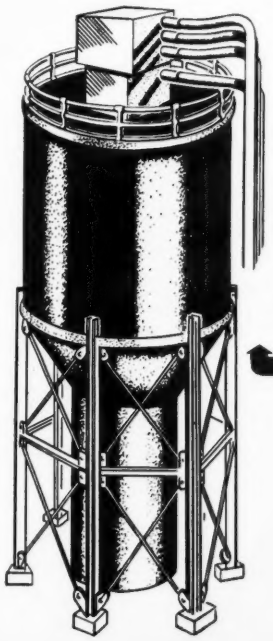
③ Service bins above Banburys hold required blacks. Weigh hopper loaded by feeders of unmatched accuracy. Weighed batch discharged directly into Banbury at controlled rate desired.



④ Central electrical control unit interlocks all operations for completely reliable performance. Panel contains graphic layout of system to permit observation of operation. Selectors allow changes in black distribution to suit needs.



① One car or two cars simultaneously unloaded into pneumatic pump and moved into proper storage bin compartment. Auxiliary bag unloading station allows small quantities of special blacks to be pumped directly into plant.



② Central storage bin holds several blacks in separate compartments. On plant demand, one or more pneumatic pumps send proper blacks into plant to maintain service bin levels.

KENNEDY-VAN SAUN

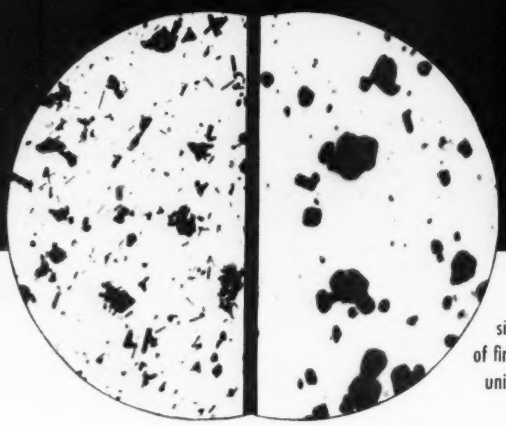
MANUFACTURING & ENGINEERING CORPORATION

TWO PARK AVENUE, NEW YORK

FACTORY DANVILLE, PA.

WHICH ZINC OXIDE GIVES the *safer* cure?

PROTOX-166
(5000 X)



ZINC OXIDE-A
(5000 X)

Protox-166 imparts safer cure because of its uniformity in each shipment, and wide range of particle size.

Not a Horse Head oxide. As a result of its low surface area, narrow particle size range, and particularly its absence of fines, it does not offer the high safety and uniformity of cure provided by Protox-166.

Protox-166*, with its wide range of particle size, gives greater safety and uniformity of cure than do comparable oxides outside the Horse Head family.

HERE'S WHY:

PROTOX-166 COLLODIAL FINES

- Give high reactivity
- Assure quick formation of zinc soaps and zinc-accelerator compounds needed for vulcanization
- Give uniform cure, because of complete dispersion

PROTOX-166 MEDIUM PARTICLES

- Act as zinc oxide reserve to prevent reversion of cure
- Impart reinforcement
- Improve aging

PROTOX-166 COARSER PARTICLES

- Speed mixing and dispersion of finer particles
- Improve processing

No zinc oxide outside the Horse Head family has such a wide range of particle sizes.

Protox-166 also imparts safer cures through its uniformity from shipment to shipment, and through its low content of lead and cadmium.

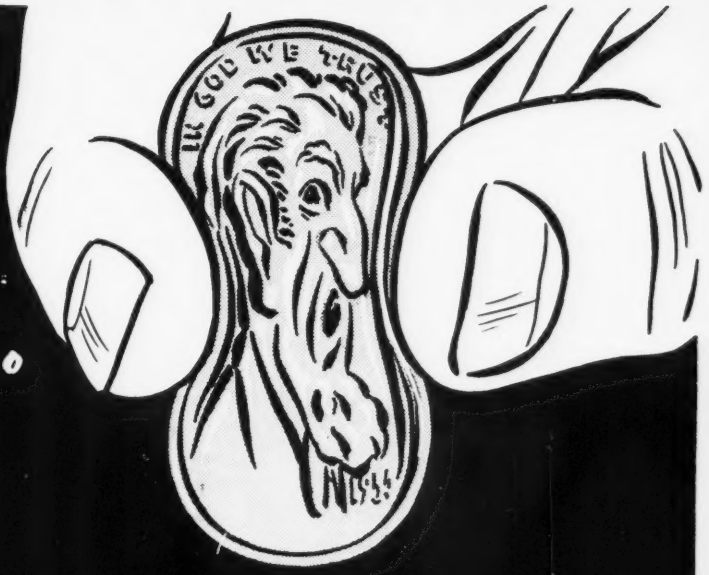
These are some of the reasons why Protox-166 is the most widely used zinc oxide in the rubber industry.

* U. S. Patents 2,303,329 and 2,303,330

THE NEW JERSEY ZINC COMPANY
Producers of Horse Head Zinc Pigments
... most used by rubber manufacturers since 1852
160 Front Street, New York 38, N. Y.

HORSE HEAD PRODUCTS

Penny-Pincher...



CYCOLAC

A *New* HIGH-IMPACT THERMOPLASTIC RESIN

gives you greater all-around ECONOMY in production!

Here at last is a single uniform resin which is permanently thermoplastic, permitting fast molding, calendering and extruding, and re-use of trim and cutting scrap.
Cycolac is also economical to form from press-polished sheets by vacuum, air-pressure, or mechanical methods over inexpensive molds of wood, plaster, aluminum, etc.

Cycolac is free from nerve or shrinkage, permitting accurate calendering and extruding. High in impact-resistance and heat-distortion temperatures; low in brittle point. Also very light with Sp. Gr. of 1.01. Capable of being colored to about any opaque shade. Capable of being solvent or heat-welded; can be machined much like other rigid thermoplastics.

GET THE FACTS — *Write* TODAY FOR TECHNICAL LITERATURE

Marbon

MARBON CORP.

GARY, INDIANA

SUBSIDIARY OF BORG-WARNER

MARBON . . . *Precision Resins for Precision Made Products*

FRANCIS SHAW

AND COMPANY LIMITED

Industry's headquarters for the best in Rubber and Plastics Machinery

FRANCIS SHAW & COMPANY LIMITED, MANCHESTER II, ENGLAND

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Enquiries to: FRANCIS SHAW (CANADA) LTD., GRAHAMS LANE, BURLINGTON, ONTARIO, CANADA.

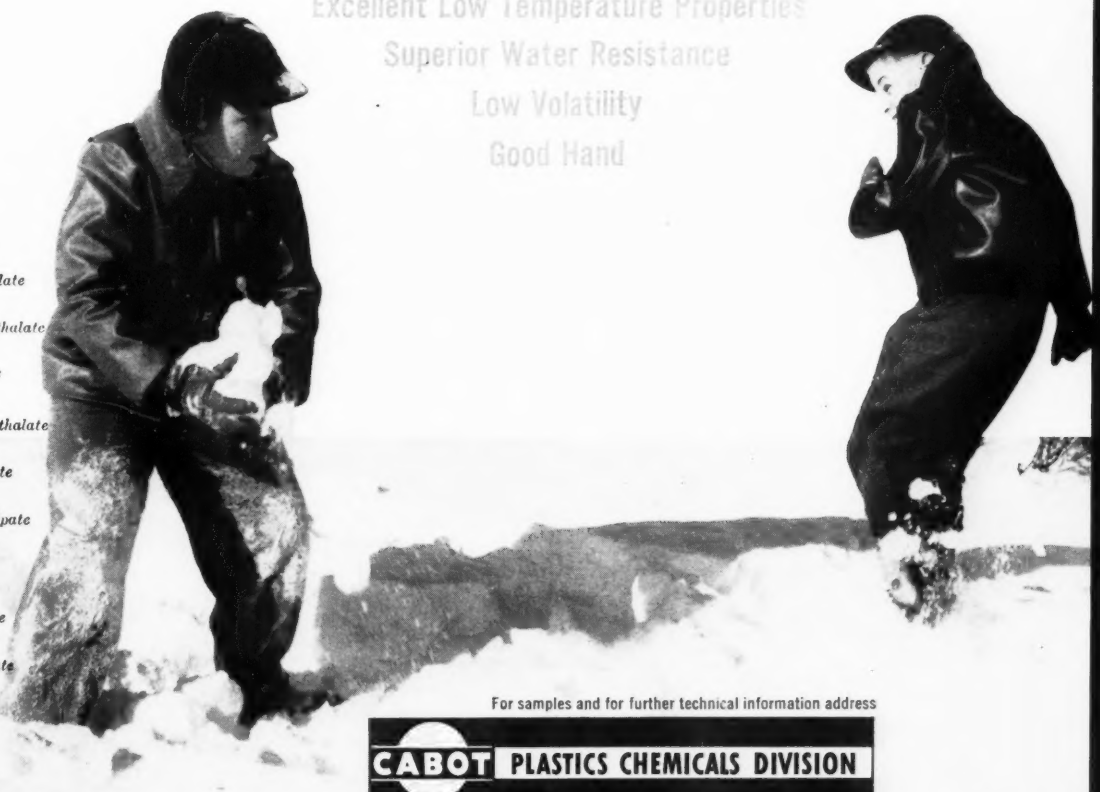
Why do manufacturers of famous outerwear vinyl specify

Cabflex® Di-OZ

Because Cabflex® Di-OZ gives **LOW TEMPERATURE PERMANENCE**

The uniformly superior quality of Cabot's di-iso-octyl azelate imparts

Excellent Low Temperature Properties
Superior Water Resistance
Low Volatility
Good Hand



- Cabflex® Di-OP *di-iso-octyl phthalate*
- Cabflex ODP *iso-octyl decyl phthalate*
- Cabflex DDP *di-decyl phthalate*
- Cabflex DOCP *iso-octyl capryl phthalate*
- Cabflex Di-OA *di-iso-octyl adipate*
- Cabflex ODA *iso-octyl decyl adipate*
- Cabflex DDA *di-decyl adipate*
- Cabflex Di-OZ *di-iso-octyl azelate*
- Cabflex Di-BA *di-iso-butyl adipate*
- Cabol 100 *hydrocarbon oil plasticizer*

For samples and for further technical information address

CABOT PLASTICS CHEMICALS DIVISION

GODFREY L. CABOT, INC. 77 Franklin St., Boston 10, Mass.

The famous "All-Weather-Jacs" worn by the boys are manufactured by Central Sportswear Manufacturing Company, Boston

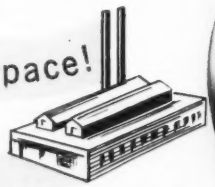
TRIM FLASHING in a Flash

and Clean as a Whistle!

Western's RMH Machine

cuts the cost of trimming as much as **75%**

a factory in a foot of space!



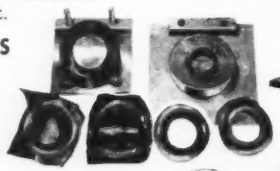
FEATURES: Cuts on replaceable hardened steel plate. Foot control speeds operation. Simple, positive pressure adjustment. ½ H.P. motor. Cutting area approx. 8½" x 9".

CUTS, PUNCHES and TRIMS in one swift operation!

DIES ARE OUR SPECIALTY

2 and 3 level dies are made for RMH. Change dies in just a few seconds with positive alignment.

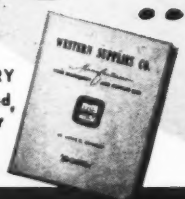
FLASHING TRIM DIES
CLICKER DIES
WALKER DIES
I. D. and O. D. DIES
MALLET DIES
MACHINE DIES



POSITIVE SAFETY FEATURES

Machine *cannot* trip accidentally. Operator can view entire operation.

GET THE FULL STORY on Western Machines and Dies by sending for our free illustrated catalog today.



SEND SAMPLES of parts to be cut and flash trimmed for our recommendations.

For Versatility—"Go Western"

Western SUPPLIES CO.

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The expansion made in recent months by
UNITED CARBON COMPANY, INC.
in its research and development departments, through enlargement of facilities and additions to the staff, has enabled the Company to intensify and broaden its program of developing new and better ways of making and using
CARBON BLACK

Kosmos 40, our high modulus gas base furnace black (HMF), has a long-established record for uniformity, easy mixing, good tubing, freedom from scorch, and a balanced reinforcement that assures high resiliency, low hysteresis, and good resistance to tear and flex.

For quieter-riding tire treads use some **Kosmos 40** — plus, of course, United's high reinforcing blacks.

UNITED CARBON COMPANY, INC.

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OPEN the DOOR

to CUSTOMER SATISFACTION

with . . .

EASY PROCESSING

Reinforcing High Styrene Resin

Marbon "8000"

Your Perfect Answer for Attractive, Colorful Automotive (Running Board) Step-Tread Stocks

- Can be added directly to your Rubber Compounds!
- Blends with Natural, Synthetic and Reclaim Rubbers!
- Provides easier moldability . . . Excellent appearance!
- Gives greater tear and abrasion resistance!
- Combines higher hardness plus higher modulus!
- Eliminates prior Masterbatching!

GET THE FACTS — *Write* TODAY FOR TECHNICAL LITERATURE

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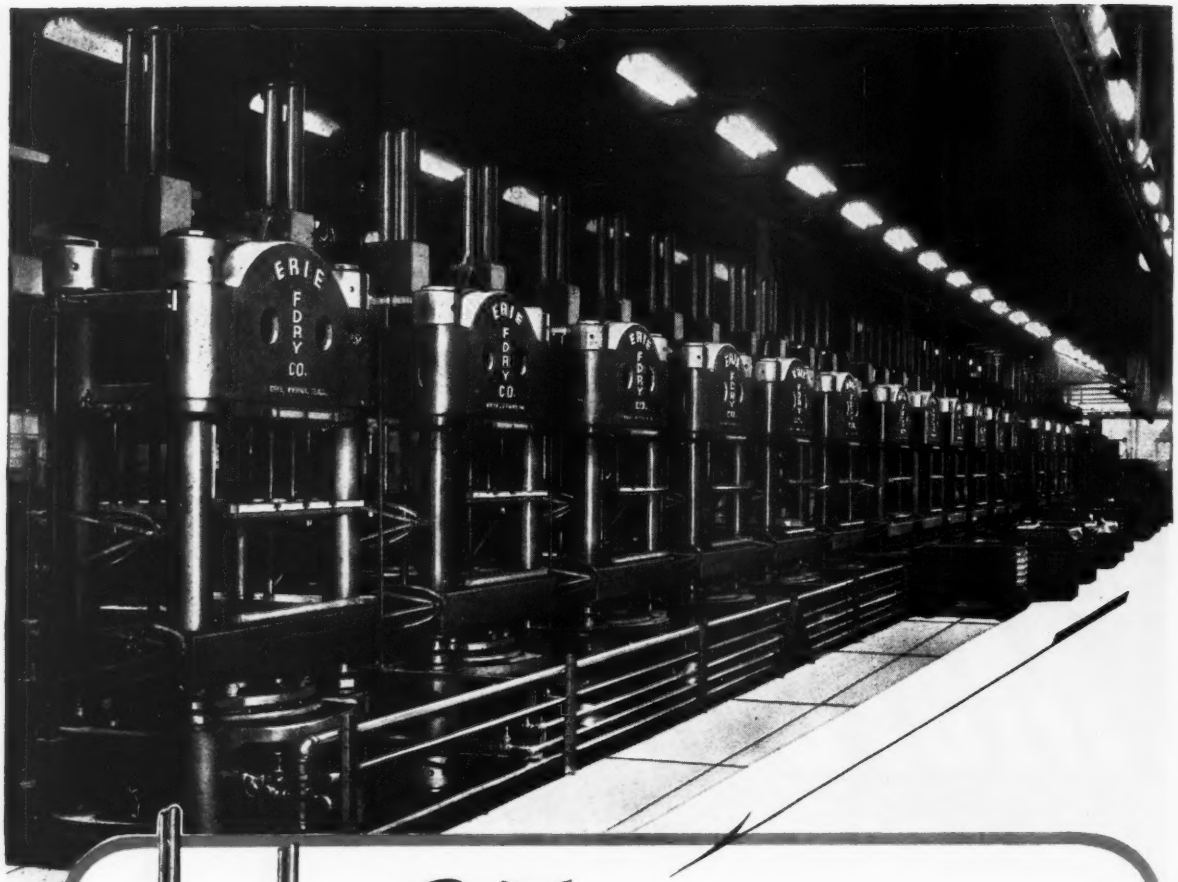
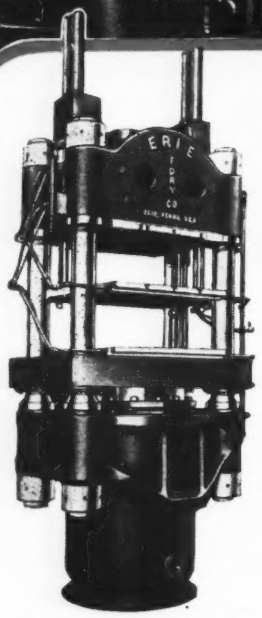
It BLENDS as it STRENGTHENS as it IMPROVES





27 ERIE HYDRAULIC PRESSES

800 TON... *for Mechanical Rubber*

THIS battery of Erie Foundry Company 800 Ton Hydraulic precision platen presses is in uninterrupted operation in the plant of one of America's leading manufacturers of rubber products. The design, engineering and construction of these presses reflects more than a half century of experience. This long experience in design and craftsmanship results in Hydraulic Presses which deliver maximum production and top quality at minimum operating and maintenance cost. Consult with us on your Hydraulic Press requirements.

ERIE

ERIE FOUNDRY COMPANY ERIE, PENNSYLVANIA

Dependable **FORGING HAMMERS • HYDRAULIC PRESSES**

NOW FOR EXCELLENT LOW TEMPERATURE FLEXIBILITY AT LOW COST

New

DRAPEX 3.2

LOW TEMPERATURE EPOXY PLASTICIZER

Drapex 3.2, at a fraction of the cost, gives your vinyls low temperature flexibility properties equivalent to dioctyl adipate. Its low volatility and low specific gravity (.905 at 20°C.) are additional economy features.

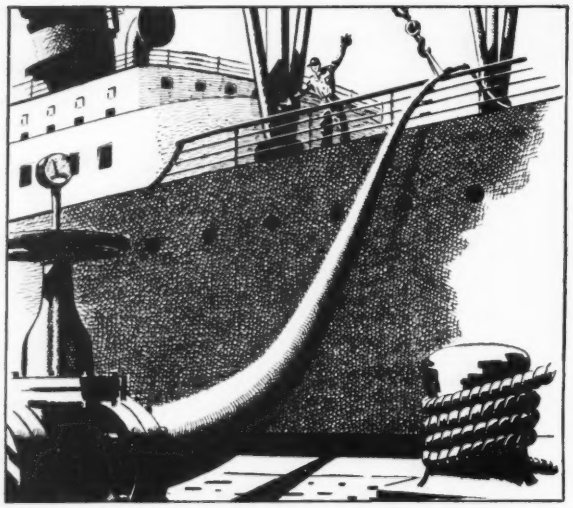
In addition, Drapex 3.2, because of its epoxy content, offers excellent stability . . . high heat resistance, low extractability, and resistance to water and sunlight.

These advantages of Drapex 3.2 will improve the quality of your vinyls at a lower cost. Why not find out how Drapex 3.2 can work for you. Write today for Technical Bulletin 4, a working sample, and the low prices of Drapex 3.2.

"PURR-FECTION"

ARGUS CHEMICAL LABORATORY

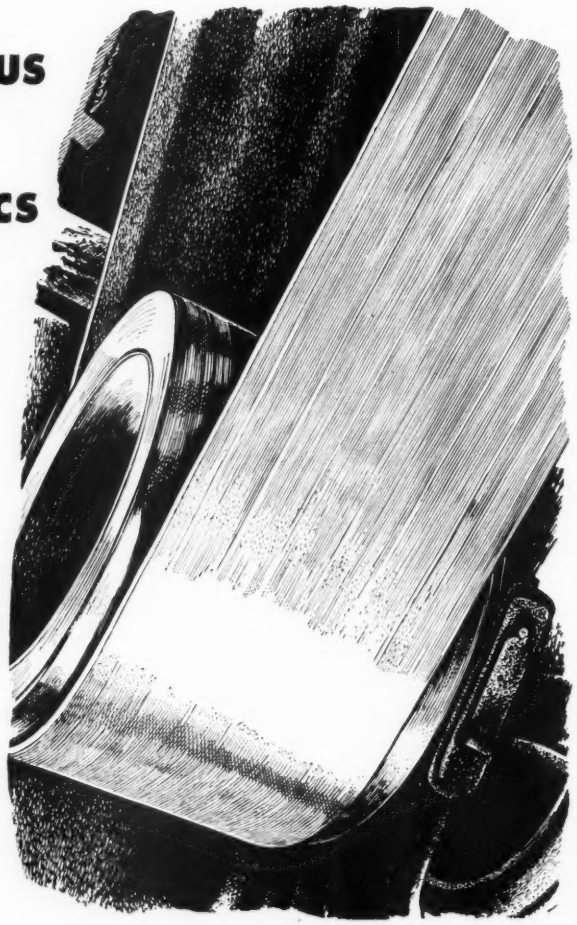
633 COURT STREET BROOKLYN 31, N. Y.



"Shawmut" hose duck is a soft, strong, plied-yarn fabric affording flexibility and good impregnation in a variety of hose applications.

"Columbus" sheeting is ideally suited for service rainwear and other rubberized products because of its constantly uniform quality.

YOU GET PERFORMANCE-PLUS WITH WELLINGTON SEARS "FIBER-ENGINEERED" FABRICS



In developing high-performance belt fabrics for the rubber industry, Wellington Sears engineers draw upon the special advantages of many textile fibers and fiber combinations.

In addition to "Shawmut" belting duck, long-known as a standard among cotton belt fabrics, Wellington Sears has developed fabrics "fiber-engineered" to meet special requirements – such as unusual strength combined with minimum weight and bulk. These fabrics give you performance-plus—service-plus—features because they utilize to the full the unique qualities of cotton, nylon, high-tenacity rayon and other fibers . . . singly or in combination.

You'll find other Wellington Sears fabrics for various mechanical rubber products, coating applications and specialties, listed below.

Write for your free copy of "Modern Textiles for Industry" which includes pertinent information on rubber applications. Address: Wellington Sears Co., Department K-3, 65 Worth Street, New York 13, New York.

Superior Fabrics for the Rubber Industry

- Belting duck
- Hose duck
- Enameling duck
- Army duck
- Single and plied-yarn chafers
- Sheeting
- Airplane cloth
- Balloon cloth
- Nylon, high tenacity rayon, other synthetics and combinations.

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FIRST In Fabrics For Industry

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Offices In: Atlanta • Boston • Chicago • Detroit • Los Angeles • New Orleans • Philadelphia • San Francisco • St. Louis

This Farrel-Birmingham "Z" Calender*

"INSURES UNMATCHED UNIFORMITY OF QUALITY"

in double-coating tire fabric

THE GOODYEAR TIRE & RUBBER COMPANY, in describing its new Farrel-Birmingham "Z" calender train, says, "It coats fabric on both sides at the same time, evenly, automatically, at constant speed, under constant weight and tension – *insures unmatched uniformity of quality.*"

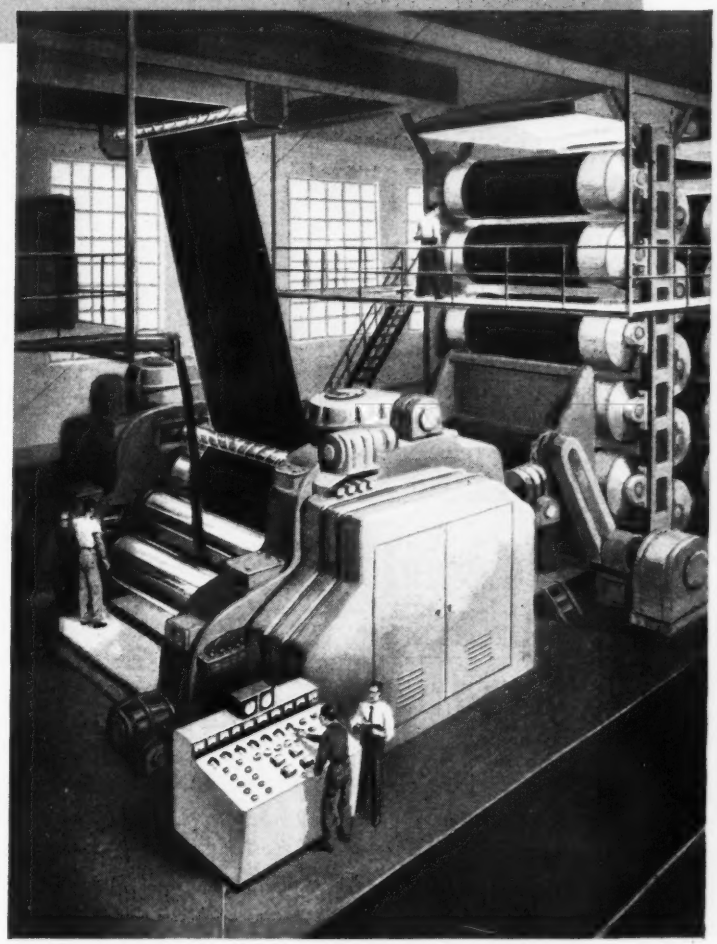
To provide this "unmatched uniformity of quality" both the upper and lower roll pairs of the calender are equipped with motorized crossed-axes devices for fine adjustment of roll "crown." Hydraulic pullbacks hold the rolls in positive operating position.

Double-coating of tire fabric is only one of the jobs in which Farrel-Birmingham "Z" calenders are establishing new standards for accuracy. They have proved to be equally outstanding for the high-speed production of rubber and plastic film and sheet, and for single coating.

Send for more information about this revolutionary development – the "Z" calender. Or, if you prefer, a Farrel-Birmingham engineer will be glad to discuss your calendering problems with you.

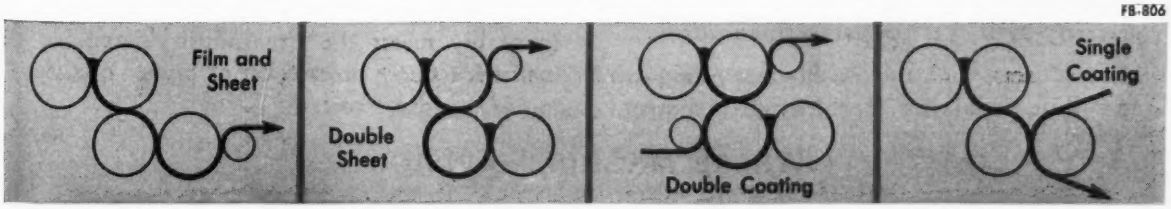
FARREL-BIRMINGHAM COMPANY, INC.
ANSONIA, CONNECTICUT

Plants: Ansonia and Derby, Conn., Buffalo, N. Y.
Sales Offices: Ansonia, Buffalo, New York, Akron, Chicago, Los Angeles, Houston



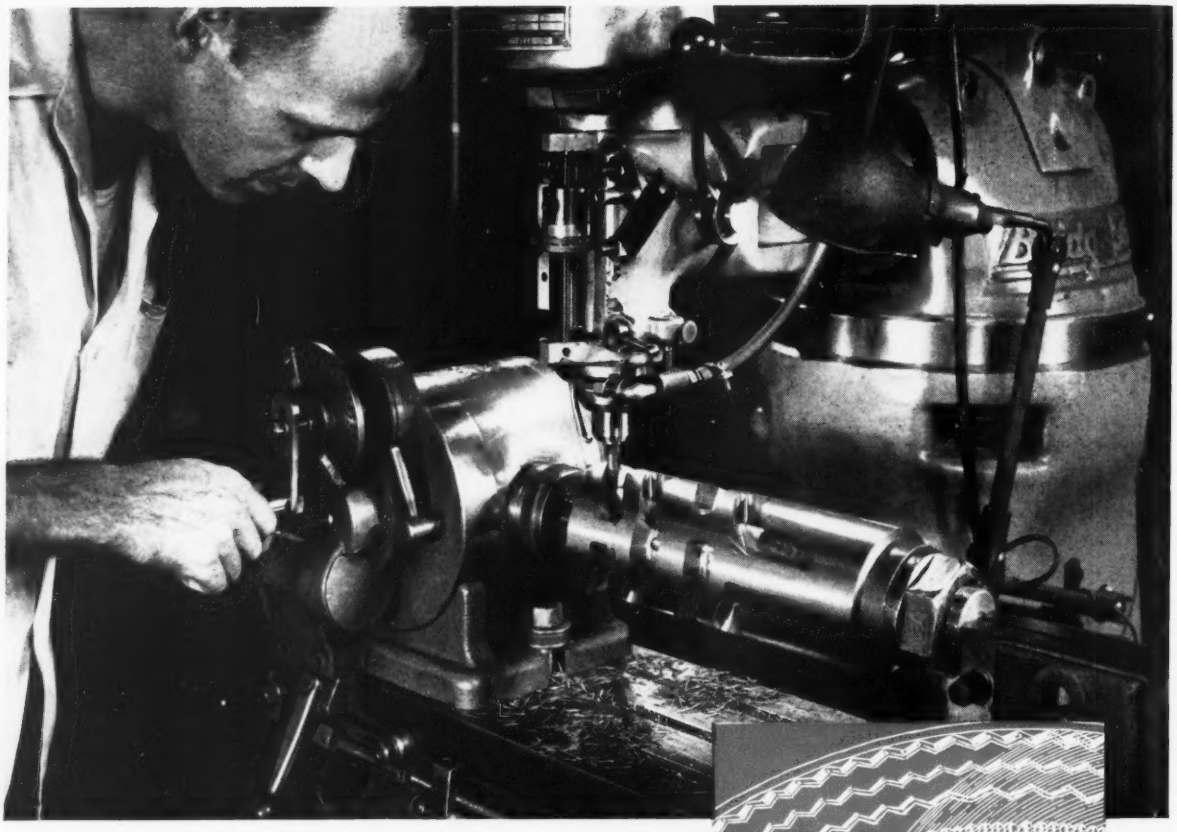
Artist's drawing of Farrel-Birmingham 28" x 70" four-roll "Z" calender double-coating tire fabric at Goodyear. This installation, which was engineered by Giffels & Vallet, Inc., Industrial Engineering Division, of Detroit, is designed for a production speed of 100 yards per minute.

FB-806



* The "Z" calender is an original development of Farrel-Birmingham Company, Inc. When you think of the "Z" calender you are thinking of Farrel-Birmingham.

Farrel-Birmingham®



"Blueprints in Steel"

assure precision engraving of

BRIDGWATER TIRE MOLDS

Skilled hands and specialized machine tools produce master cams like this one, in the tire mold plant of Bridgwater's Athens Machine Division, Athens, Ohio. These cams are virtually "blueprints" made of steel, since each is an unerring record of minute details in the design of an automotive tire tread. When completed, the cam will become the "brain" which enables a Bridgwater Engraving Machine to reproduce in a tire mold, a tread design *precisely* as it was originally planned.

Master cams, and the Bridgwater designed and built Engraving Machines they control, are typical examples of *many* precise methods and machines used at Athens to speed manufacture of finest quality precision molds, and yet keep the cost of these molds at lowest possible levels.

At Bridgwater's Athens Machine Division, skilled craftsmen and specialized machine tools have but *one* obligation . . . to produce fine molds of any type or size, in engraved steel, cast iron or aluminum, on a basis which most favorably meets the tire industry's requirements for *faster* production of higher quality molds, at lower cost.

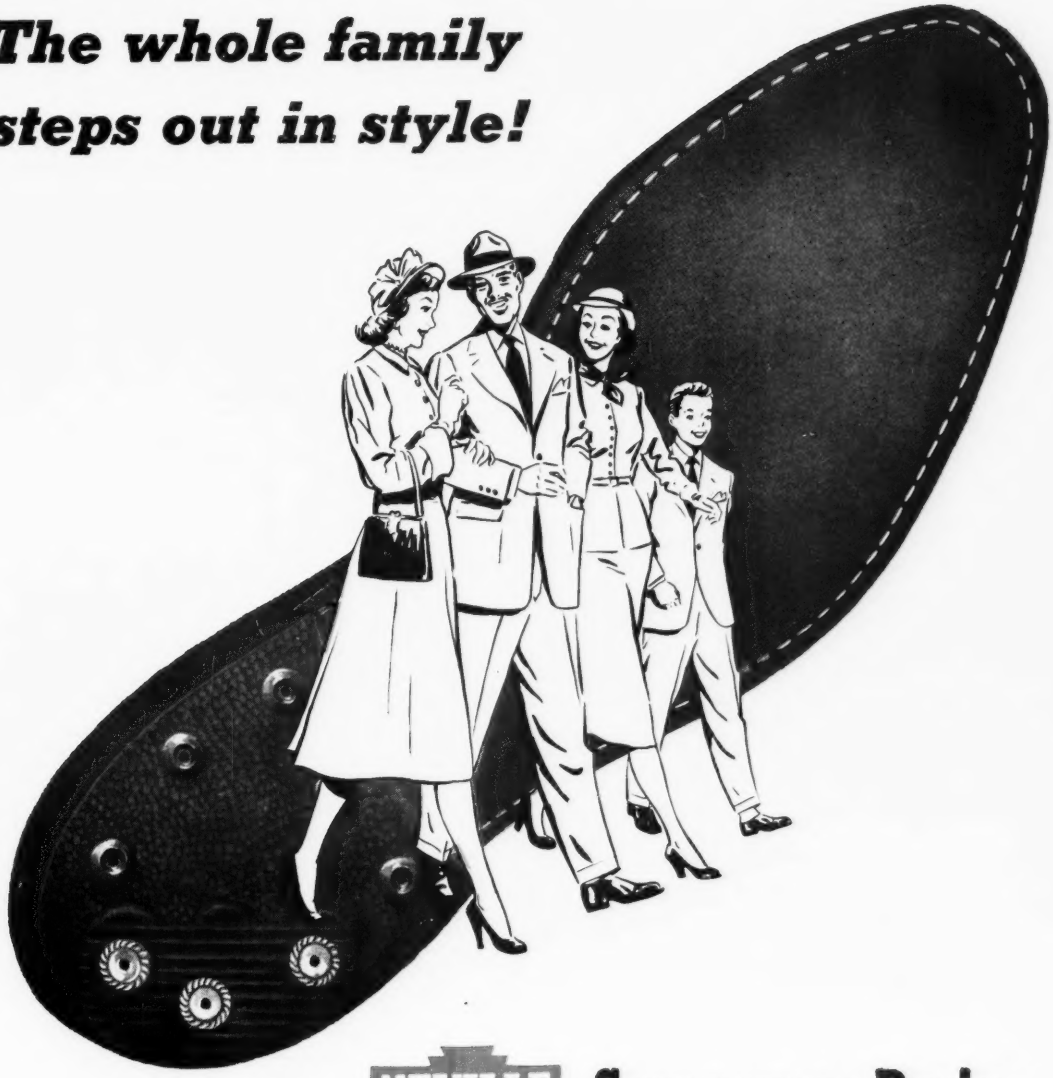
1903

ATHENS MACHINE DIVISION

BRIDGWATER MACHINE COMPANY

Akron, Ohio

The whole family steps out in style!



. . . thanks to NEVILLE **Coumarone Resins**

Why not call on Neville's years of experience and "know-how" to help you in your particular problems.

PRODUCTS OF TOMORROW FROM THE CHEMICALS OF TODAY

The buyer of shoes looks for style, lightness, flexibility, comfort, waterproof protection and long wear!

The manufacturer, on the other hand, in order to guarantee these necessary selling points, seeks tensile strength, abrasion resistance, flex-life and uniform quality in the stock he uses for producing quality foot-wear!

That's why Neville Coumarone Resins are being used in sole and heel compounding in ever-increasing volume. Through them manufacturers enjoy improved properties and production advantages, building tack in their compounds without sacrificing hardness, tensile or tear.

NEVILLE CHEMICAL CO. • PITTSBURGH 25, PA.

Plants at Neville Island, Pa., and Anaheim, Cal.

VINYL COMPOUNDS *Custom Mixed by* CARY CHEMICALS

High quality compounds, for wire and cable, extruded products, mechanical goods, and other applications.

- Accurately mixed
- Tailor-made exactly to specifications

Write Dept. "W" for complete details.

Cary Chemicals Inc.

Successors to BURGESS CHEMICAL CO.

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CARY CHEMICALS PRODUCTS:

- Vinyl Compounds
- Vinyl Plasticizers
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- Reclaiming Oils
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- Esters
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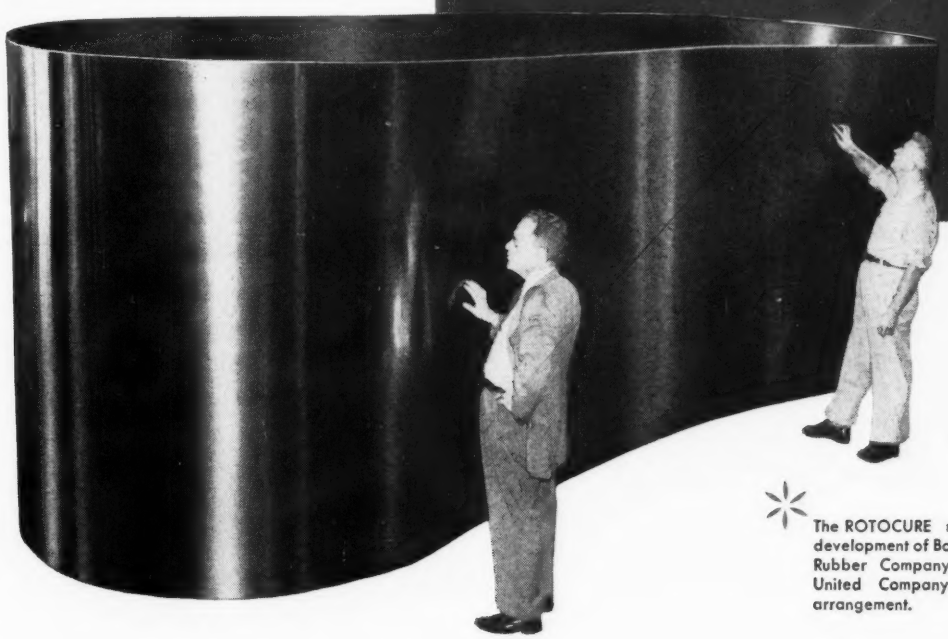
we did it . . . and we're glad

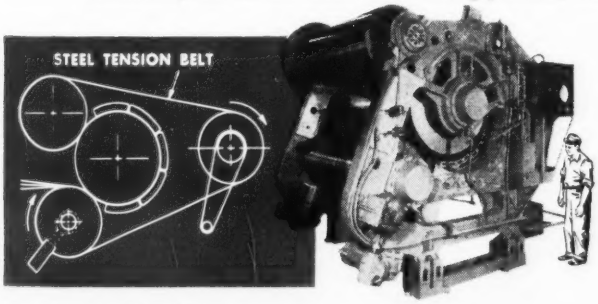


The ROTOCURE machine is a patented development of Boston Woven Hose and Rubber Company, built by Adamson United Company under a licensing arrangement.

These men are looking for imperfections. But they're stumped. There aren't any.

That's why we're glad we designed and built the large special grinding machine that ground and polished that giant steel band to so smooth a surface and high luster.

The band is the *tension belt* of a ROTOCURE*, a machine for the *continuous curing* of flat rubber goods, conveyor belting, floor coverings, gasket materials, etc. In the continuous curing process, the stock moves, under pressure and tension, between a vulcanizing drum and the tension belt; and until **Adamson Engineers** designed and built the ROTOCURE* BELT GRINDER, the imperfections or irregularities in the belt surface were reflected in the finished product.



ROTOCURE* and schematic diagram of operation.

On this new Adamson machine, ROTOCURE* belts can now be ground to tolerances of plus or minus one-thousandths of an inch, which means that a flatter, smoother, more accurate, better looking and longer wearing product can be made.

Problems such as the creation of this special grinding machine are all-in-the-day's-work at Adamson. Design is our business. We've been engineering and building precision equipment and processes for conventional or unusual requirements for over 60 years.

If you have a problem in machine design or product improvement, chances are, we can be of help.

'Phone or write us; without obligation, of course.

ADAMSON UNITED COMPANY

730 Carroll Street • Akron 4, Ohio

SALES OFFICES IN PRINCIPAL CITIES

Subsidiary of United Engineering and Foundry Company

Plants at: Pittsburgh • Vandergrift • New Castle • Youngstown • Canton

The wrong solvents cause trouble, too!

Skellysolve for Rubber and Related Industries

Applications

SKELLYSOLVE-B. For making quick-setting cements for the shoe, tape, container, tire and other industries. Quick-drying, with no foreign taste or odor in dried compound.

SKELLYSOLVE-C. For making quick-setting cements with a somewhat slower drying rate than those compounded with Skellysolve-B.

SKELLYSOLVE-D. For cements and variety of manufacturing operations. Good odor. Quick drying. Minimum of heavy, greasy compounds.

SKELLYSOLVE-H. For general use in manufacturing operations and cements, where faster evaporation rate than that of Skellysolve-D is desired.

SKELLYSOLVE-E. For use wherever a relatively slow drying solvent is desired.

SKELLYSOLVE-R. For general use in tire building and a variety of other manufacturing operations and cements. Reduces evaporation losses. Medium quick final dry. Lessens bloating and skinning tendency.

"Doc" MacGEE says: The water that Junior pours into Dad's gasoline tank is nothing compared to the Cain that can be raised by the wrong solvents in your manufacturing processes. Guard your plant against such expensive possibilities by putting your solvent requirements in the hands of the solvent pioneers and specialists—the men of Skellysolve!

You can count on the quality of Skellysolve—batch after batch its uniformity is always "right on the button." The reason: more than 24 years of specializing in solvents, and the strictest of quality controls.

Strictly what you want, too, are Skellysolve's solvent properties. Check for low end points, quick evaporation, reduced blushing tendency, low vapor pressure, a minimum of unsaturates and pyrogenic decomposition products plus a minimum of low and high boiling compounds. You'll find Skellysolve has it!

Skellysolve has what you want, also, for controlled vapor pressure—your assurance against bloated containers. And especially vital to rubber cement manufacturers, Skellysolve's minimum of low boiling compounds assures freedom from "seeds," while its minimum of greasy residues means superior bonding strength.

Write now for more complete technical facts about Skellysolve.

SKELLY

Skellysolve

INDUSTRIAL DIVISION, SKELLY OIL COMPANY
KANSAS CITY, MISSOURI

here are 4 good reasons why STAUFFER leads in SULPHURS:

1 Crystex
(85% insoluble sulphur)
does *not* bloom
on uncured stock

2 Tire Brand
(99.5% pure) sulphur
for general use

3 Tube Brand
refined to meet special requirements

4 Special Flowers
(30% insoluble)
lowest cost per unit of "I.S."

STAUFFER SULPHURS for rubbermakers are available in various forms, to serve every purpose in the rubber industry. All sulphurs from Stauffer are carefully manufactured to meet exacting specifications.

AND SPECIAL PURPOSE GRADES OF SULPHUR

In addition to superior sulphur products, Stauffer has available these quality chemicals for the industry:

CAUSTIC SODA
CARBON TETRACHLORIDE
CARBON DISULPHIDE
SULPHUR CHLORIDES
BORAX

"You can always depend on chemicals from Stauffer!"

Send *now* for literature fully explaining the advantages and uses of these and other Stauffer products.

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Stauffer CHEMICALS SINCE 1885

For Rubber Compounding Use VELSICOL RESINS

NOW AVAILABLE IN VARYING MELTING-POINT RANGES AND COLORED GRADES

SOME SUGGESTED APPLICATIONS:

- Mechanical Goods
- Electrical Insulation Compounds
- Rubber Shoe Soles and Heels
- Rubber Floor Tiling
- Gaskets and Jar Rings
- Rubber Adhesives and Cements
- Molded Rubber Products
- Tubular Compounds
- Reclaimed Rubber Sheeting
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- Battery Cases
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FEATURES:

1. THERMOPLASTIC HYDROCARBON RESINS.
2. COMPATIBLE WITH NATURAL AND SYNTHETIC RUBBERS.
3. EFFECTIVE PLASTICIZERS AND SOFTENERS . . . in highly-loaded clay stocks or in recipes incorporating carbon black.
4. MILL READILY.
5. EXCELLENT DISPERSING AGENTS FOR FILLERS AND PIGMENTS.
6. FACILITATE PROCESSING PROCEDURES . . . impart excellent milling, calendering processing and tubing characteristics to stocks.
7. IMPART EXCELLENT PERFORMANCE CHARACTERISTICS . . . such as good tensile strength, elongation and modulus, as well as good resistance to abrasion and aging.
8. POSSESS HIGH ELECTRICAL RESISTANCE PROPERTIES.
9. AID IN THE DEVELOPMENT OF NON-SCORCHY STOCKS . . . without excessive retardation of cure at high temperatures.

For additional information concerning properties and applications of Velsicol Resins, WRITE:

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General Offices and Laboratories
330 East Grand Avenue, Chicago 11, Illinois

Export Division
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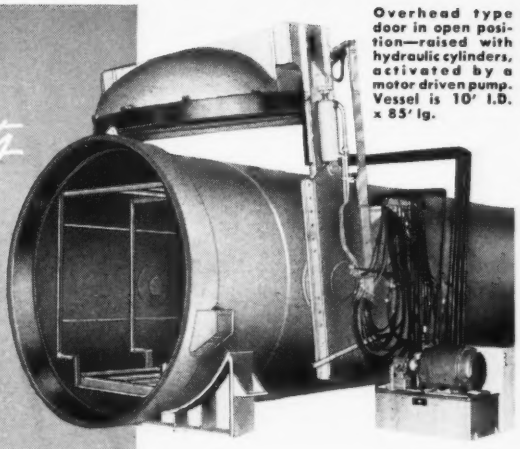
STRUTHERS WELLS

Patented Engineering Achievements

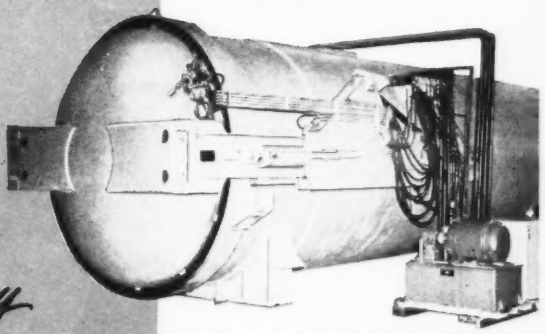
provide important advancements in

QUICK OPENING DOORS



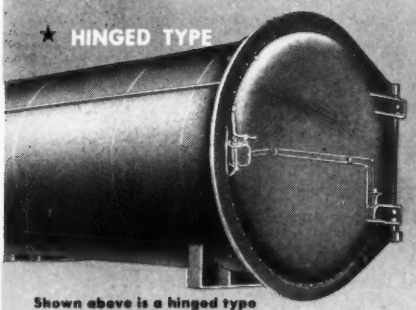
Overhead type door in open position—raised with hydraulic cylinders, activated by a motor driven pump. Vessel is 10′ I.D. x 85′ lg.

Same 10′ dia. vessel as above, with door in closed position.



★ OVERHEAD TYPE

★ HINGED TYPE



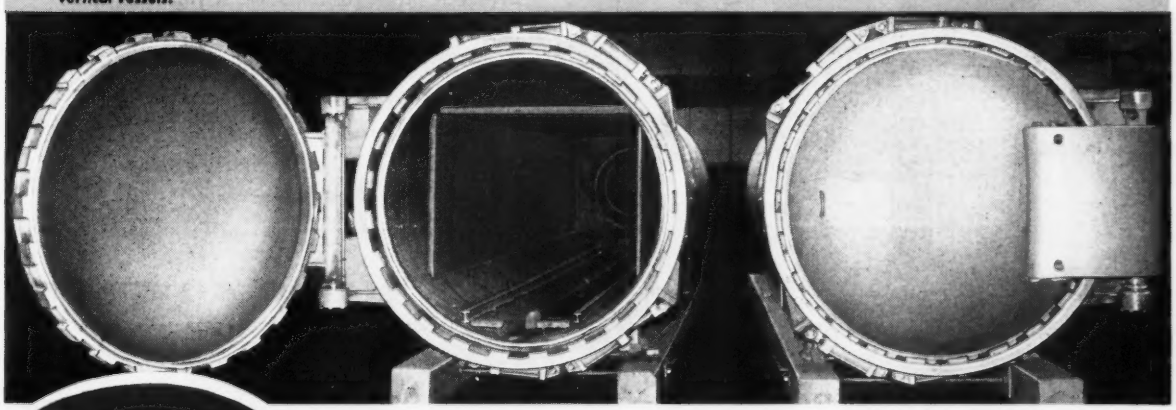
Shown above is a hinged type door which is mounted on anti-friction bearings and is manually operated.

...for every industry

Complete simplicity of operation, ease in handling, faster opening and closing, important saving of floor space, and a lifetime of dependability are some of the outstanding features of Struthers Wells Quick Opening Doors—for every industry. Investigate these engineering achievements for your Quick Opening Door applications.

★ LUG TYPE

Shown below in open and closed position, the lug type door can be provided for horizontal or vertical vessels.



Consult Struthers Wells for Quick Opening Doors best suited to your specific requirements.

STRUTHERS WELLS CORPORATION

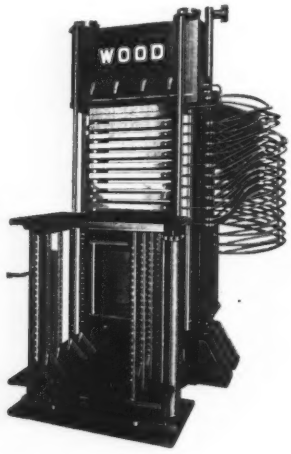
Process Equipment Division • **TITUSVILLE, PA.**

Plants at **TITUSVILLE, PA.** • **WARREN, PA.** • *Offices in Principal Cities*

How do you feel about leaning ladders?

IN RUBBER AND PLASTICS, THE PAYOFF'S AT AN R.D WOOD PRESS LIKE THIS ONE!

This 880-ton multiple opening platen press is designed for polishing and laminating plastic sheets. The complete ten opening sheet production unit includes a twenty opening loading and unloading elevator. R. D. Wood hydraulic presses are made in a full range of sizes and capacities, for many uses. Ask for catalog, and for engineering aid—both yours without obligation.



If you're human, it's likely that you've been tempted, at one time or another, to put superstition to the test. But—you probably decided *not* to walk under that ladder on the theory that it's better to let well enough alone. If you acted the same way in business . . . if you didn't feel compelled to know the always changing facts about production, markets, methods and all the rest . . . you'd have trouble in bunches. Take an hydraulic press, for instance. If your business uses presses, you ought to know something about them . . . how they can profit you. Find out about a Wood press—and be pleasantly surprised. You owe it to your stockholders. Ask for descriptive catalog.

R. D. WOOD COMPANY

PUBLIC LEDGER BUILDING • PHILADELPHIA 5, PENNSYLVANIA

Representatives in Principal Cities

MAKERS OF HYDRAULIC PRESSES AND VALVES · FIRE HYDRANTS · CAST-IRON PIPE · GATE VALVES · GAS PRODUCERS · ACCUMULATORS

profit with CALCENE® NC

When your compounding calls for an extremely fine precipitated calcium carbonate, choose Calcene NC. You'll benefit from reduced volume cost, and high quality performance.

Calcene NC (non-coated) provides many desirable properties to your finished products including good tensile, elongation, hot tear resistance, hardness, abrasion resistance, resilience and flexing.

The use of Calcene NC in wire and cable insulation contributes to better electrical properties. In molded goods, Calcene NC provides a good white, will not interfere with delicate pastels.

For a non-black, reinforcing agent that emphasizes quality and economy, look into Calcene NC. Additional information and working samples are available by writing Rubber Pigment Department at our Pittsburgh office.

HI-SIL and SILENE USERS

For your added convenience, Columbia-Southern® is now packaging Hi-Sil® and Silene® in more compact paper bags than were formerly used. This new size will make it easier for you to handle and store.

TABLE OF PROPERTIES

CALCENE NC — Precipitated Calcium Carbonate (non-coated)

Bulk Density	18 ± 2 lbs./cu. ft.
Specific Gravity	2.7
Average Particle Size	0.1 micron
Color	White
Free Moisture	0.6% maximum
Wet Screen Test	0.1% max. on 325 mesh
Oil Absorption (Rub-in-method)	40-50

CHEMICAL PROGRESS WEEK-MAY 17-22

COLUMBIA-SOUTHERN CHEMICAL CORPORATION

SUBSIDIARY OF PITTSBURGH PLATE GLASS COMPANY

ONE GATEWAY CENTER · PITTSBURGH 22 · PENNSYLVANIA

DISTRICT OFFICES: Cincinnati • Charlotte • Chicago • Cleveland • Boston • New York • St. Louis Minneapolis • New Orleans • Dallas • Houston • Pittsburgh • Philadelphia • San Francisco

Original and major source of supply!

POLYBUTENES

An important raw material in a variety of mechanical rubber products

Since 1935, when Oronite Polybutene was first produced and sold, these important raw materials have become widely used in a variety of rubber products. Their light color makes them specially acceptable for compounding light-colored molded rubber goods.

PROPERTIES: Oronite Polybutenes are clear, light in color, tacky, chemically inert liquids. They will not become gummy or waxy, do not harden, darken or change in any essential property over long periods of atmospheric exposure. Oronite Polybutenes can readily be emulsified using standard techniques and equipment. In the emulsified form or in their natural form, they are useful as tackifiers, plasticizers or extenders for natural or synthetic rubber products. Available in a number of high viscosity ranges to meet your requirements. Write or call any Oronite office for Polybutenes technical bulletin.

ORONITE CHEMICAL COMPANY

38 Sansome St., San Francisco 4, Calif. • 714 W. Olympic Blvd., Los Angeles 15, Calif.
30 Rockefeller Plaza, New York 20, N. Y. • 600 S. Michigan Ave., Chicago 5, Ill.
Mercantile Securities Building, Dallas 1, Texas 2904

AN *Invitation* TO ALL OWNERS OF BANBURY* MIXERS

FARREL-BIRMINGHAM COMPANY
INCORPORATED

CONSOLIDATED MACHINE TOOL CORP. ROCHESTER, N.Y.
WHOLLY OWNED SUBSIDIARY

PLANTS: ANSONIA AND DERBY, CONN.; BUFFALO, N.Y.
GENERAL OFFICES: ANSONIA, CONN.

ANSONIA, CONN.

Gentlemen:

It is our policy to offer free inspection of Banbury mixers to our customers. We like to inspect mixers at least once a year to determine the amount of wear on all gears, bearings, rotors, mixing chamber, etc. At the same time we will also inspect any other Farrel-Birmingham equipment you may have in your plant.

The inspection necessitates stopping a machine for about one hour, and having a man available to assist our inspector.

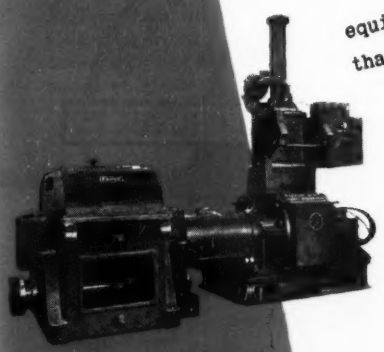
A full detailed report with recommendations will be made to you.

If you would like your Banbury Mixers or other equipment inspected, you may call or write and set a date that is convenient for you.

Yours very truly,
FARREL-BIRMINGHAM COMPANY, INC.

W. D. Taylor

W. D. Taylor
Manager Service Department



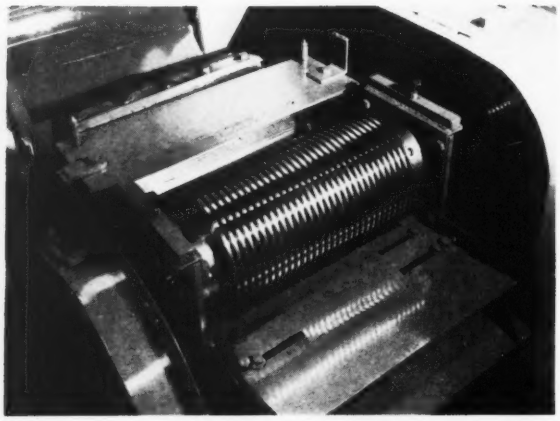
HEAVY MACHINERY FOR THE RUBBER, PLASTICS, METAL, PAPER, SUGAR AND OTHER INDUSTRIES
ROLLS • CASTINGS • WELDMENTS • GEARS AND GEAR DRIVES

FB-894

*Trade Mark

Dice Plastics and Rubber Accurately with

TAYLOR-STILES DICING CUTTER



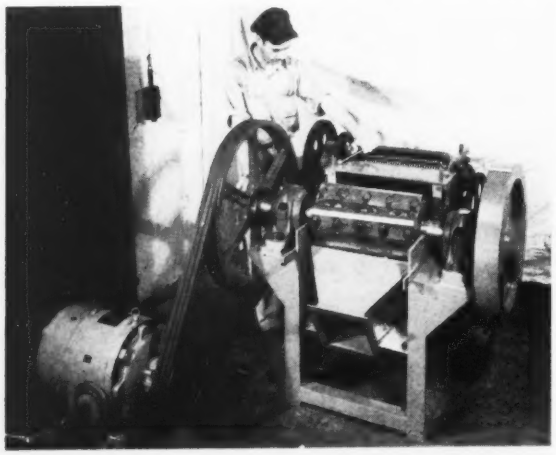
(above)—Closeup of feed and circular shears that give stock the first cut in dicing.

This precision machine is used for cutting plastic or rubber stock into pellets of uniform size for molding, for extruding, and for other purposes in the process of manufacture, without fines.

Also cutters for molding blanks, scrap chopping, and almost any cutting operation.

For full description of this machine, write us about your rubber or plastics cutting needs.

(below)—Rear view of dicing cutter showing revolving knife head that cross cuts strips as they come from the circular shears, into precise pieces for molding and extruding.



TAYLOR-STILES & COMPANY

16 Bridge Street, Riegelsville, New Jersey

VULCANIZED VEGETABLE OILS

—RUBBER SUBSTITUTES—

•

Types, grades and blends for every purpose, wherever Vulcanized Vegetable Oils can be used in production of Rubber Goods—be they Synthetic, Natural, or Reclaimed.

•

A LONG ESTABLISHED AND PROVEN PRODUCT

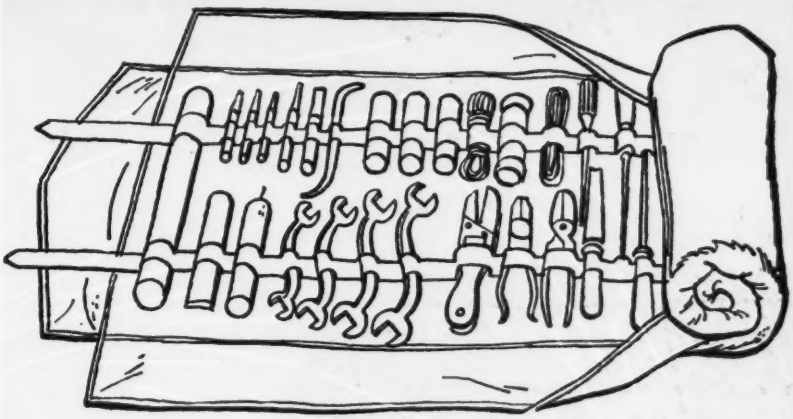
THE CARTER BELL MFG. CO. SINCE CARTER BELL PRODUCTS 1903 SPRINGFIELD, NEW JERSEY

Represented by:

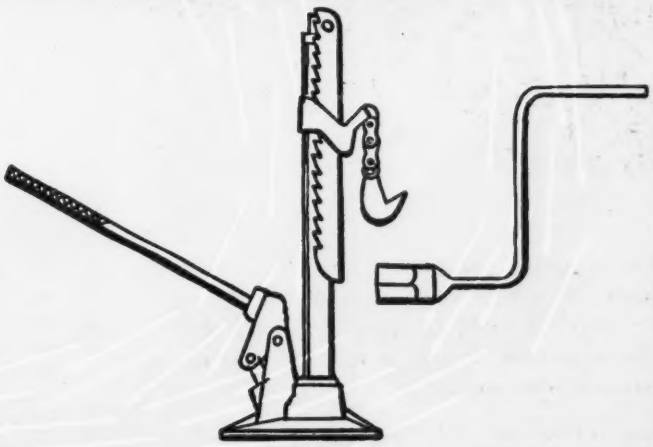
HARWICK STANDARD CHEMICAL CO.

Akron — Boston — Trenton — Chicago — Denver — Los Angeles

How long
did it take
to get
from here



to here?



Answer:
Twenty years.

The eighteen-pound kit containing 38 tools was considered just what the motorist needed in 1906. Gradually, as automobiles improved, the need for tools decreased until approximately twenty years later a simple jack was the main tool carried by motorists.

And as cars improved, the rubber industry grew along with them, until today it is one of the largest in the country. Monsanto has played an important part in this progress. Its complete line of accelerators, antioxidants and special materials for rubber are virtually standards of the industry.

For complete information about these products:

Get your copy of the new catalog, "Chemicals for the Rubber Industry." Entirely revised and up-to-date, this catalog is now available. Send for your copy now. Write to MONSANTO CHEMICAL COMPANY, Rubber Chemicals Department, 920 Brown Street, Akron 11, Ohio.

MONSANTO
CHEMICALS – PLASTICS

SERVING INDUSTRY
WHICH SERVES MANKIND

MONSANTO CHEMICALS FOR THE RUBBER INDUSTRY

ANTIOXIDANTS
Flectol* H
Santoflex* B
Santoflex BX
Santoflex 33
Santoflex AW
Santowhite* Crystals
Santowhite MK
Santowhite L
Santowhite Powder
ALDEHYDE AMINE ACCELERATORS
A-32
A-100

MERCAPTO ACCELERATORS
Santocure*
El-Sixty*
Mertax (purified Thiotax)
Thiotax (2-Mercapto benzothiazole)
Thiofide* (2,2' dithio-bis benzothiazole)
GUANIDINE ACCELERATORS
Diphenylguanidine (D.P.G.)
Guantal*
ULTRA ACCELERATORS FOR LATEX, ETC.
R-2 Crystals
RZ-50
RZ-50-S

Pip-Pip
Thiurad* (Tetramethyl-thiuram disulfide)
Ethyl Thiurad (Tetramethyl-thiuram disulfide)
Mono Thiurad (Tetramethyl-thiuram monosulfide)
Methasan* (Zinc salt of dimethyl dithiocarbamic acid)
Ethasan* (Zinc salt of diethyl dithiocarbamic acid)
Butasan* (Zinc salt of dibutyl dithiocarbamic acid)
SPECIAL MATERIALS
Thiocarbanilide ("A-1")
Santovar*-A
Sulfasan R
Insoluble Sulfur "60"
COLORS
REODORANTS

*Reg. U. S. Pat. Off.

These TINY, COLORFUL, PRECISION-CUT FIBERS...

Industry's Most Versatile Product

Cellusuede **FLOCK**

Flocked rubber glove, illustrated above, was produced in Cellusuede's well-equipped sample department as part of an ever-expanding program to assist flock users with special problems.

The unending variety of uses for Cellusuede Flock stirs the imagination of industry's most progressive minds. Cellusuede adds COLOR APPEAL in packaging, paper, and many other fields . . . gives an intriguing RICH TEXTURE to fabrics and toys . . . SILENCES unwanted noises when used as an acoustical material, everywhere from architecture to aircraft . . . DAMPENS VIBRATION in radio grills and phonograph turntables . . . INCREASES STRENGTH when used as a filler in plastics and rubber . . . thousands of uses, and every day designers, engineers, research and production men are finding more applications for Cellusuede Flock.

ENGINEERING SERVICE

Call on Cellusuede engineers and research men, without obligation, for data on how Cellusuede Flock may be applied to your job. WRITE FOR NEW BULLETIN illustrating profitable uses and application methods.

CELLUSUEDE PRODUCTS, INC.

PRODUCERS OF NATURAL AND SYNTHETIC FLOCK

[illegible] North Madison Street, ROCKFORD, ILLINOIS

TAKE IT EASY *by Polyco*

"Poor Harry! He's still trying to find the right polymer!"

It's a hopeless task trying to keep up-to-date on polymeric resins. The industry comes up with something new and better every day.

So, take it easy! Just contact the American Polymer Company, a firm that does nothing but polymerize—and polymerizes all resins. Then, make it responsible for giving you the properties you need.

Such a challenge is always welcome at American Polymer Company. Here, we *personalize polymers* to fit specific applications.

What kind? All kinds! Today it might be a polyvinyl acetate emulsion . . . or solution. Tomorrow, a styrene-butadiene latex . . . a vinyl copolymer emulsion . . . an acrylic copolymer solution . . . or a butadiene-acrylonitrile latex. To date, we've polymerized resins in thousands of different formulas.

Investigate! Learn more about our personalized polymer service. Have a confidential talk with our representative. Why not write today?

POLYCO

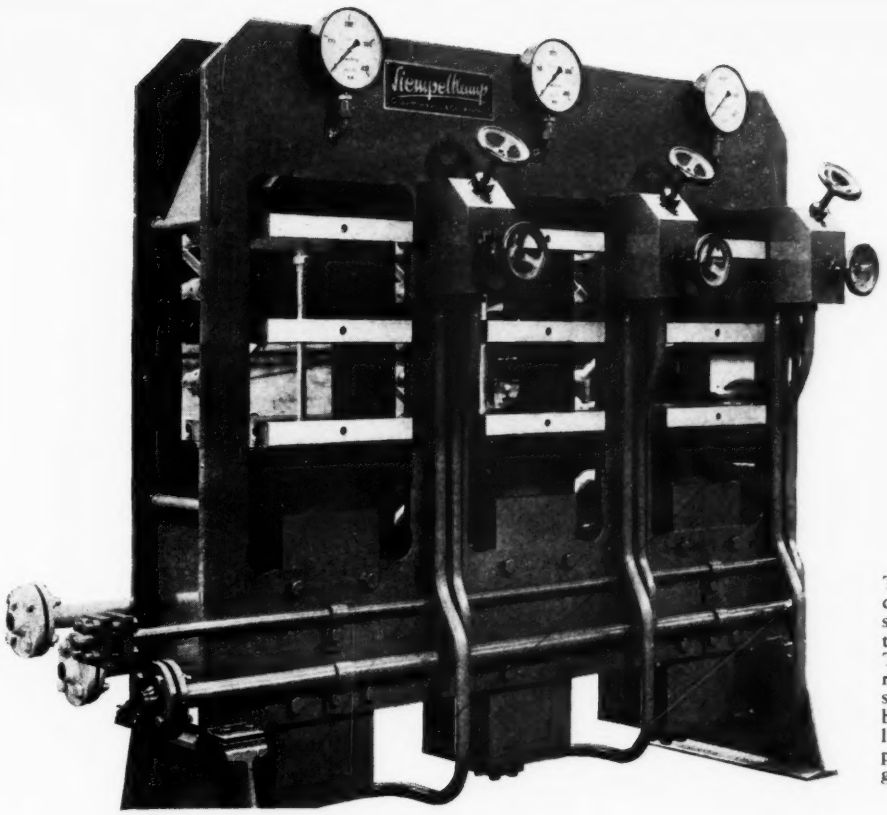
AMERICAN POLYMER CO.

Chemical Division, The Borden Company

General Offices: 101 FOSTER STREET, PEABODY, MASSACHUSETTS

Personalizes ALL KINDS OF RESINS

Send for *this NEW comprehensive brochure covering POLYMERS FOR ADHESIVES. It will show you how to take advantage of American Polymer Co.'s personalized polymer service. Write American Polymer Co., Peabody, Mass., for brochure P-55, POLYMERS FOR ADHESIVES. It's* **FREE!**



This stripped multiple press clearly shows one of the superior Siempelkamp features: Frame Construction. The frame, built of thick rolled high tensile steel sheets, eliminates the possibility of broken tie rods and loosened nuts. Finished presses, of course, have fully guided platens.

Siempelkamp

Announces the appointment of

WILLIAM TAPPER

30 South Broadway, Yonkers, N. Y.

as its exclusive representative to
the Rubber and Plastic industries.

Siempelkamp has been building hydraulic presses since 1883 and this experience, plus traditional Old World craftsmanship, assures highly satisfactory, trouble-free performance. Send your specifications or requirements, and drawings will be furnished without obligation.

Siempelkamp presses are priced so as to offer substantial savings to users. This important feature alone deserves your most serious consideration. As for terms, Siempelkamp offers an unusual opportunity: A direct and attractive credit arrangement to all well rated companies.

All U. S. A. inquiries should be sent to:

WILLIAM TAPPER

30 South Broadway, YONKERS, N. Y.

Phone: Yonkers 3-7455 Cable: Wiltapper

All other inquiries should be sent directly to:

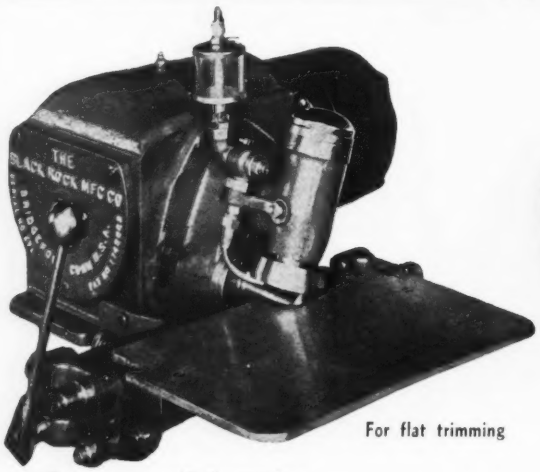
SIEMPELKAMP & CO.

KREFELD, WEST GERMANY

Telex: 0853 811 Cable: Siempelkampco

IMPROVE YOUR TRIMMING PRODUCTION

. . . with a BLACK ROCK 4TA



For flat trimming

For circular trimming

- Cutters are self sharpening.
- Mechanism completely enclosed.
- Unit driven by an integral 1/6 H. P. motor.
- Ball bearing mounted.

The Black Rock 4TA Rubber Trimmer is the most compact, sturdy . . . yet flexible machine made. Designed for accurate and rapid work, it trims flat as well as circular pieces and possesses many exclusive features.

WRITE TODAY FOR BULLETIN #19A

FINE BR TOOLS

BLACK ROCK MFG. CO.

177 Osborne Street — Bridgeport 5, Conn.

N. Y. Office, 261 Broadway

MOLDS

any capacity to

60 inches by 30 feet long

We specialize in straight and varying cross-section molds for production of sponge rubber weatherstripping for aircraft and automotive industries.

Molds for use in McNeil and Glader presses.

We also manufacture molds for V-belts, belting, rails, etc.

ACE MACHINE AND MOULD COMPANY, INC.

17 COLUMBUS AVENUE — GARFIELD, N. J.

Designers and manufacturers of molds for rubber goods since 1925

Get in touch with

PICCO

for high quality, dependably uniform

SOLVENTS AND SOLVENT OILS

HAVE YOU TRIED PICCO SOLVENTS?

Here are some typical applications—

For non-staining reclaim for automobile and truck tires—**HiFlash Naphtha**

For non-staining pan reclaim—**HiSolv 30**

To swell rubber away from metal parts—**Picco Solvent Oils**

For cleaning machinery—**Heavy Naphthas**

For use in tubeless tires—**Aromatic Plasticizers**

As a cut-back for high melting point resins, to enable the manufacture of low micron size emulsions for latex compounding—**HiSolv Naphthas**

For any type of reclaim process—**Picco Reclaiming Oils**

For film casting—**HiSolv T**

In rubber cements—**LBAN (low-boiling aromatic naphtha)**

To swell rubber away from rubber-covered wire—**575 Oil**

In sponge rubber—**Piccocizers**

In high styrene butadiene co-polymer resins for solvent-applied finishes—**HiSolv Aromatic Petroleum Naphthas**

PENNSYLVANIA INDUSTRIAL CHEMICAL CORPORATION CLAIRTON, PA.

Plants at Clairton, Pa.; West Elizabeth, Pa.; and Chester, Penna. *District Sales Offices:* New York—Chicago—Philadelphia—Pittsburgh

Distributed by HARWICK STANDARD CHEMICAL COMPANY, AKRON 5, OHIO

Pennsylvania Industrial Chemical Corp. (IRW)
Clairton, Pennsylvania

Please send complete specifications and samples of the following PICCO SOLVENTS and SOLVENT OILS:

- ☐ Coal Tar Aromatics
- ☐ Coal Tar Heavy Naphthas
- ☐ Solvent Oils
- ☐ Heavy Oils
- ☐ Aromatic Petroleum Naphthas
- ☐ Hisolv Heavy Naphtha

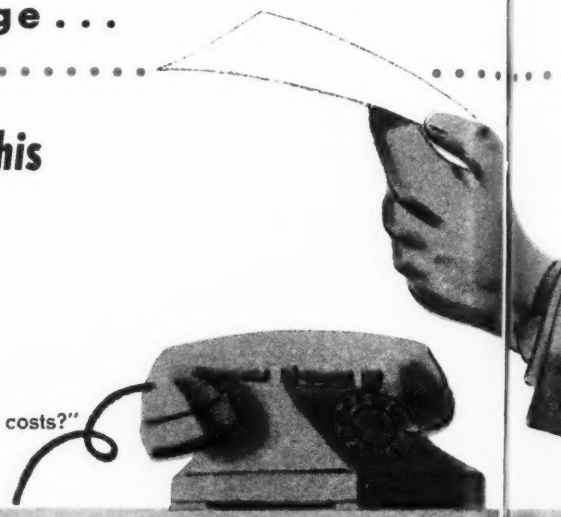
Name_____ Position_____

Company_____

Address_____

Only the BOSS of the

should read this message . . .



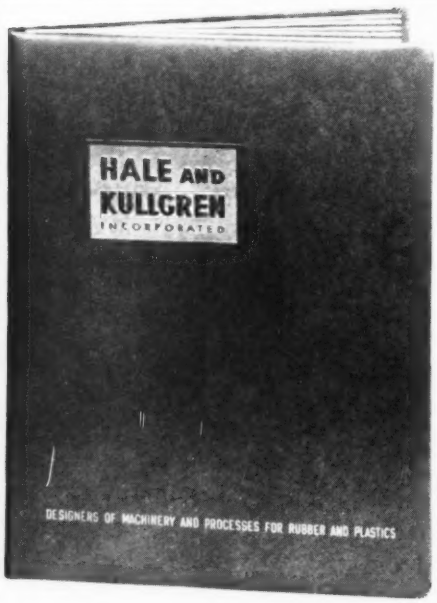
and he should read it only if his profit picture is bothering him

"Would modernization of our processes or layout pay off?"
"Can my scrap loss be reduced?"
"Does the quality of some of my products need a boost?"
"Are our conversion costs in line?"
"What new methods are available which would improve our costs?"

If you boss a company which manufactures tires, mechanical goods, hose or other products from rubber or plastics, you recognize these questions and ideas. You are bombarded with them all the time.

Wouldn't you like to have in your hands, an authoritative guide embracing such items as: Analysis of cost factors in actual operations; physical changes which would permit reduction of costs; specific equipment recommendations; a layout of your plant as it is today; a comparison to show what changes could be made to improve your costs and profits and a projection of new costs which justify the proposed capital expenditures.

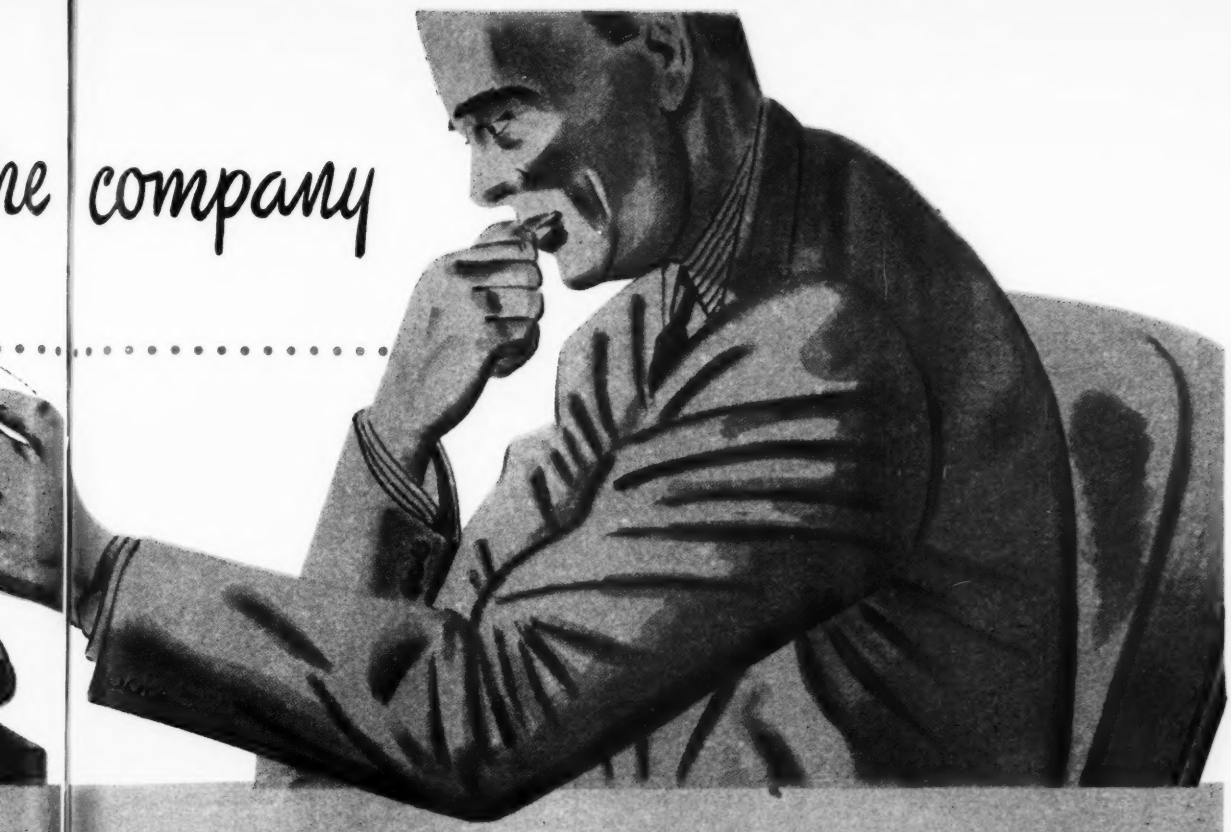
Perhaps you have found yourself many times in the position of having to make



one study (and survey report)

Many companies

1. Proposed ultimate production schedule.
2. Plant layout—present and future.
3. Description of proposed processes including direct and indirect labor requirements.
4. Detailed description and cost of plant modifications and new equipment.
5. Projected manufacturing costs based on modernized plant and processes.
6. Appendix of supporting data.



company

decisions on capital expenditures with questionable justification for the proposals. Competent consultants are available to study sales, physical facilities, cost accounting and other special phases of your business. But, haven't you at times needed an experienced group to make the most important study of all—the actual physical operation of your plant in relationship to costs and profits.

In these days of tough competition more and more industries are turning to automation to minimize conversion and material costs. A consultant group thoroughly experienced in the engineering and operating phases of the rubber and plastics industry can be of invaluable help in applying the principles of automation to accomplish cost reduction in your plant.

at modest cost can lead to increased profits

have proved this point

This service has paid off for several companies. Recent studies by our group include: a heel and sole plant; a toy company; a mechanical goods plant; a plastic plant; and a few tire companies. In some cases the report has pointed out savings that could be made through simple changes in procedure (without capital expenditure) that more than paid for the cost of the report.

Remember this—the study will be invaluable to you as a manager, whether you actually make any capital expenditures or not. You will have a blueprint for future growth and modernization. That alone will help you make many sound decisions.

What's needed?

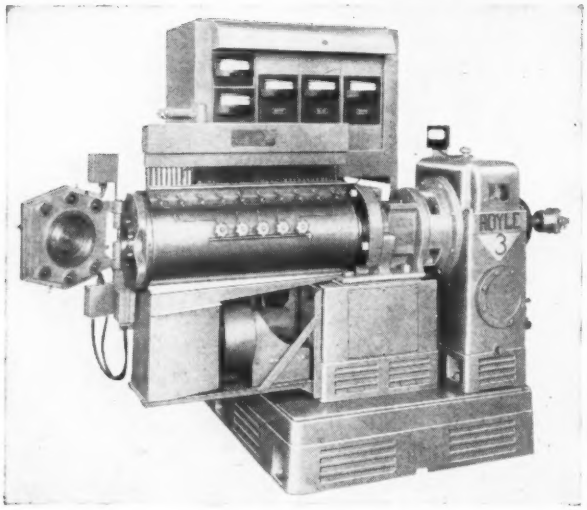
A preliminary talk will cost nothing. A representative of Hale and Kullgren will be happy to visit your office at your convenience.

CONSULTANTS FOR RUBBER AND PLASTICS

HALE AND KULLGREN INCORPORATED

associated with The Aetna-Standard Engineering Co.
MACHINERY BUILDERS

FASTEST HEATING FASTEST COOLING



Here are some of the time-tested, money-saving reasons more and more plants are standardizing with Royle Spirod* Extruders for processes requiring maximum flexibility in controlled temperatures — constantly maintained and accurately zoned:

- **Extra heavy walled cast steel cylinders that will not warp. No joints to leak when pressures are high or crevices to collect burned compound that would cause contamination.**
- **Heavy duty large diameter heating elements, that can be used with 440 volts without step-down transformers, provide radiant heat to cylinders and heads.**
- **Any heating element may be removed and replaced without disturbing other elements or wiring.**
- **A cooling system with ten times the capacity of conventional designs can be modulated through its entire temperature range without drastic changes. Ample cooling for all compounds at maximum speeds.**

No. 3 Royle Spirod Extruder. Completely insulated and equipped for evaporative cooling.

*Patent Applied For

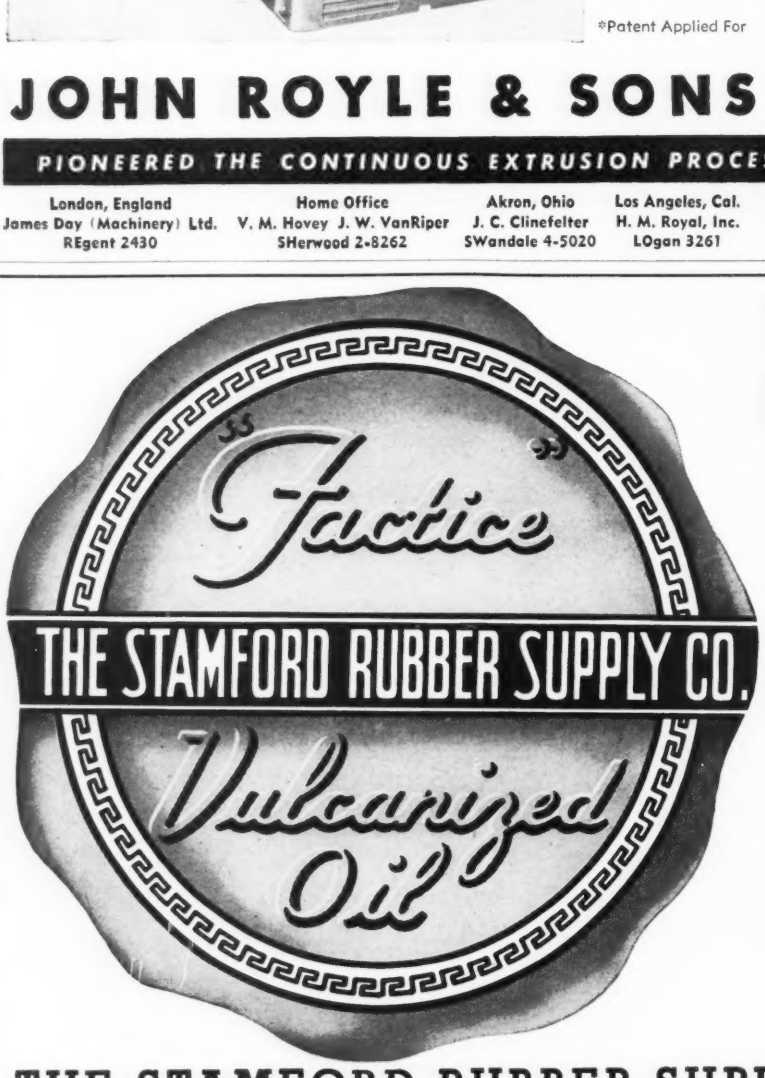
JOHN ROYLE & SONS

ROYLE PATERSON N. J.

PIONEERED THE CONTINUOUS EXTRUSION PROCESS IN 1880

London, England	Home Office	Akron, Ohio	Los Angeles, Cal.
James Day (Machinery) Ltd.	V. M. Hovey J. W. VanRiper	J. C. Clinefelter	H. M. Royal, Inc.
REgent 2430	SHerwood 2-8262	SWandale 4-5020	LOgan 3261

PATERSON 3, NEW JERSEY



THE SEAL OF DEPENDABILITY

Our products are engineered to fill every need in natural and synthetic rubber compounding wherever the use of vulcanized oil is indicated.

We point with pride not only to a complete line of solid Brown, White, "Neophax" and "Amberex" grades, but also to our hydrocarbon solutions of "Factice" for use in their appropriate compounds.

Continuing research and development in our laboratory and rigid production control has made us the leader in this field. The services of our laboratory are at your disposal in solving your compounding problems.

Oldest and Largest Manufacturers of "Factice" Brand Vulcanized Oil Since 1900

Reg. U.S. Pat. Off.

THE STAMFORD RUBBER SUPPLY COMPANY

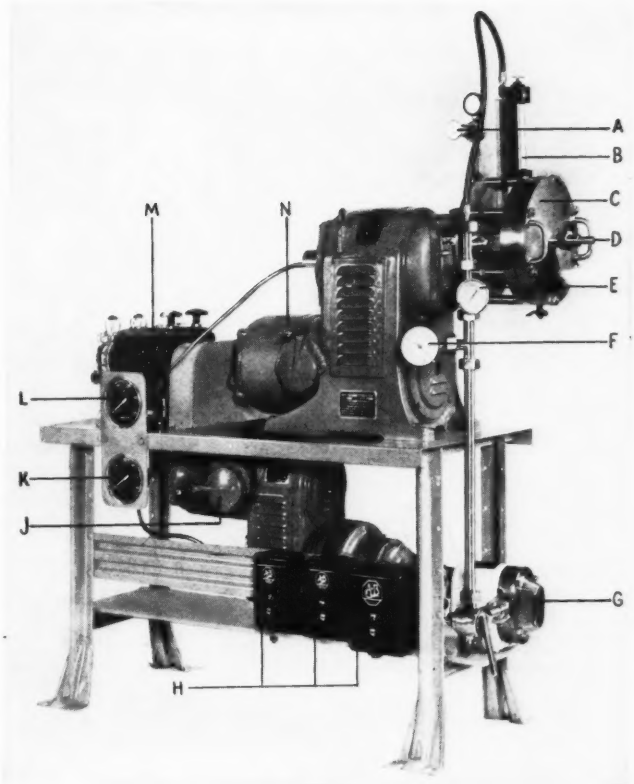
Stamford, Conn.

FOAM RUBBER MIXING BY PUSH-BUTTON METHOD!

Continuous — Automatic!

We know this may sound a bit bombastic because foaming latex by oldtime conventional batch methods is a sticky business that takes a lot of back and brawn, and leaves plenty of room for error. But continuous, automatic, push-button mixing under fingertip control is now being provided by Oakes Continuous Automatic Mixers in large and small plants everywhere. The superiority of product is such, and the savings so substantial in so many directions, that plants wishing to maintain their competitive position in today's swiftly expanding market are finding Oakes Mixers an absolute essential.

The Oakes Continuous Automatic Mixer is capable of foaming latex to a blow-up of as much as 16 to 1, with a throughput capacity of 50 to 1800 pounds of wet latex per hour—predetermined density can be obtained at will and held uniformly. The resultant product is of exceptional quality—uniformly fine-celled and velvet-smooth, with maximum strength. Production is up to 900 pounds per hour with the smaller model, and up to 1800 pounds per hour with the larger. Savings in latex and all other formula materials, of as much as 15% have been realized; "rejects" have been reduced as much as 75%. In plants producing upwards of 1,000 pounds per hour savings in labor have been as much as six people. Foam is more stable. Injection molding is made possible. Less floor space is required; refrigerated, air conditioned rooms are unnecessary. These are but a few of the features that have made the Oakes preferred equipment.



A. Air Pressure Regulating Valve
B. Air Flowmeter
C. Mixing Head
D. Discharge Hose Connection
E. Product Thermometer
F. Pressure Gauge
G. Latex Pump
H. Starting Boxes
J. Pump Speed Regulator
K. Pump Tachometer
L. Mixer Speed Tachometer
M. Chemical Proportioning Pumps
N. Mixer Speed Regulator

Oakes Continuous Automatic Mixer

Available only through

THE E. T. OAKES CORPORATION

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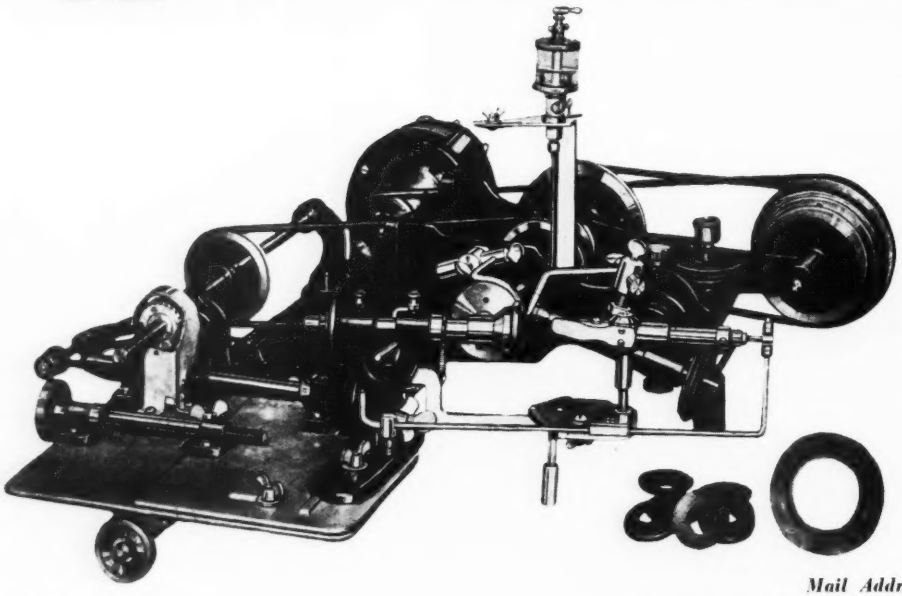

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Industry Sponsored Rubber Research Program[1]

H. J. Osterhof[2]

THE formulation of legislation for disposal of the government owned synthetic rubber facilities to private industry has raised an important question as to the future of synthetic rubber research, particularly basic or fundamental research. This is a question in which I know all of us here are very much interested. When plant disposal takes place, *what* research will be conducted, and *who* will pay for it? There seems to be a rather widespread, but entirely erroneous, impression in certain government and scholastic circles that industry will not support an adequate amount of fundamental research when the government withdraws from the business. In this brief talk I propose to correct that impression. My own opinion is that enough fundamental research will be carried out by private industry to keep pace with all the possible demands on an expanding synthetic rubber industry.

During the past year the rubber industry has been devoting a great deal of attention to the question of continuation of synthetic rubber research. More recently an outstanding public service has been performed by India RUBBER WORLD, during the period, July-December, 1953, when it tried to stimulate thinking in the rubber industry by a series of editorials reporting the results of a survey of research and development administrators on the future of fundamental research on synthetic rubber. This survey on the "who and where" of future basic research on synthetic rubber reveals that two-thirds of the respondents lack confidence in the government program and believe that private industry may be depended upon for an adequate volume of fundamental research, if and when the synthetic rubber plants are sold by the government to private industry.

To those of you who have not read them, I recommend this series of editorials very highly. I shall quote liberally from them in the course of this talk.

Were it not for reasons of national security there would be no problem created by the impending sale of government owned synthetic rubber facilities. However, it is of extreme concern to the Department of Defense, since it involves loss of the Reconstruction Finance Corp. financed rubber research program, and since, in a global war, complete dependence might have to be placed on synthetic rubber.

THIS article represents further industry comment on the series of editorials which appeared in India RUBBER WORLD, July through December, 1953, and an article entitled, "A Plan for Synthetic Rubber Research and Development," which appeared in our December, 1953, issue.

Dr. Osterhof's article has recently been released for publication by the Department of Defense. Another article with a different point of view will be presented in June.

Industry is fully prepared to take on all phases of research on synthetic rubber, including financial support of pioneering reasearch, along with its manufacture.

Industry, on the other hand, will finance only those types of applied research where the potential volume of the end-product will provide a return which will cover research and development expenditures.

Dr. Osterhof suggests a questionnaire to determine if operation of the Government Evaluation Laboratory in Akron, O., is desired by the rubber industry, and, if so, that the National Science Foundation take the responsibility for its supervision.

---

[1]Presented at Joint Army-Navy-Air Force Conference on Elastomer Research & Development, Washington, D. C., Jan., 1954. This article represents the personal views of the author and not necessarily those of the Department of Defense.

[2]The Goodyear Tire & Rubber Co., Akron, O.

RCF on Rubber Research

The facts of the case, which are very well stated, along with a questionable conclusion, are described in "Program for Disposal to Private Industry of Government Owned Rubber-Producing Facilities."[3] I quote:

"It is therefore important, for reasons of national security, that research in rubber, fundamental as well as applied and developmental, continue. Some of the important research goals still to be attained are: the development of a synthetic that can substitute for natural in large tires; the development of processes placing minimal reliance on strategic and critical materials in short supply and in high demand for other purposes in wartime; and the development of special-purpose polymers satisfactory for essential military uses. In addition to these immediate goals, there remain long-range problems of a more fundamental character, such as the development of new monomers for improved polymers, and research on the preparation and properties of elastomers (substitutes for rubber) generally.

"There is no doubt that once the plants are disposed of, the purchasers will devote themselves to research. The spur of competition and the pecuniary advantage to be derived from patent rights would seem to guarantee that research will be accelerated. It is probable that the bulk of such research, however, will be applied and developmental, of direct interest to plant operations and commercial products, thus paralleling the research presently performed under contract by the plant operators. . . .

"It is likely, therefore, that the government may find it necessary to continue its research in rubber in those areas where problems of major strategic importance remain to be solved."

Paley Report on Rubber

This rather pessimistic view of the willingness of industry to involve itself in the fundamental research which obviously is absolutely necessary for growth of the synthetic rubber industry might be justified if there were no peacetime industrial future for synthetic rubber, and its only outlet was for the Department of Defense. However, an opposite picture is painted in the Paley Report,[4] issued in 1952. This report states that the consumption of rubber in the United States can be expected to continue to grow vigorously, possibly doubling over the next 25 years. An even greater rate of increase can be expected in the other free countries, so that the total free-world demand for new rubber by about 1975 may possibly be around 2½ times 1950 consumption. Eventually there can be expected a growth of demand that will require construction of new capacity for synthetic rubber production.

It appears likely that synthetic rubber supplies will continue to increase in relative importance and may account for as much as 50 to 60% of the total supply of new rubber around 1975. Free-world demand for new rubber, as projected, would total some five million long tons by 1975. If natural rubber production does expand to what appears to be the most reasonable outside limit of 2.5 million long tons by 1975, synthetic rubber supply would still need to provide 2.5 million long tons by 1975.

Pioneering *vs.* Applied Research

In view of this forecast, it is my opinion that *basic research* on synthetic rubber, which aims to increase our background knowledge as differentiated from *applied research* directed at doing a specific job, will be carried out vigorously by private industry when the government withdraws its present support. Perhaps, however, we should pause for a moment for a definition of research since much of the question as to the research that government has been sponsoring or that industry will perform probably is due to misunderstanding caused by non-consistent terminology. The fields of fundamental research, background research, applied research, and development are well defined and illustrated by The President's Scientific Research Board.[5] Parenthetically, I might add that, based on these definitions, during the past 10 years of government financed synthetic rubber research there has been practically no fundamental research, and that probably no more than 15% of the total would even classify as background research.

Owing to the unavoidable intermingling of the various types of research in any new project, I prefer to divide the entire field into pioneering research, applied research, and development, where pioneering research comprises the necessary proportions of fundamental, background, and applied research. For example, pioneering research involves the attempt to reach a general goal such as the preparation and study of elastomers of previously unknown characteristics. The attempt to reach a specific goal, such as an improved elastomer equal or superior to natural rubber for use in large, heavy-duty tires, would be an example of applied research; while an even more specific goal, such as construction of heavy-duty tires from present GR-S to be equivalent to natural rubber tires, properly comes under development.

A general impression of what industry may, or may not, do is presented in a very recent article in India Rubber World.[6] I quote:

"The current government synthetic rubber program represents a complete spectrum of scientific and industrial activities. The operations include fundamental research, background and applied research, development, pilot-plant operation, evaluation and testing and large-scale manufacture. There is general agreement that private enterprise will be adequate to conduct manufacturing operations and the necessary supporting applied research and development, together with testing and evaluation. There are fears, however, that fundamental research, in the true meaning of the term, may not be adequately provided for in the new decentralized industry. Also, many persons feel the need of retaining a central pilot-plant and evaluation laboratory that will be available to both government and industry. Others, however, think that the pilot-plant operation is unnecessary, and that industry will give ample support to research of all kinds.

"The principal objective of the research that has been conducted by the government thus far has been to support and improve production. With the sale of the plants the responsibility for this type of research should be assumed by those who buy the plants, and the government should direct its efforts toward fundamental research. . . . If American industry is to continue to develop, it must support long-range fundamental research on the broadest possible base. . . . Hence, until the new synthetic rubber industry can organize to finance and operate a strong fundamental research program, it is essential that the government take the lead and retain those parts of the program which should be continued."

Since the only possible points creating an issue are questions of so-called fundamental research, of applied research and development for the Department of Defense, and of the disposition of the government pilot-

[3] P. 38, Reconstruction Finance Corp., Washington, D. C. (March 1, 1953).
[4] "Resources for Freedom, The President's Materials Policy Commission, U. S. Government Printing Office, Washington, D. C., June, 1952.
[5] "The Federal Research Program, A Report to the President," by John R. Steelman, Chairman, Sept. 27, 1947, pp. 300-301, 311-14.
[6] India Rubber World, Dec., 1953, p. 345.

plant, the remainder of this discussion will be confined to these specific problems.

Commenting generally on this article, I feel confident that industry is fully prepared to take on all phases of the research on synthetic rubber, along with its manufacture. It is my opinion that the synthetic rubber business can stand completely on its own feet without the necessity of any government financing of its research program. Industry, as well as other research centers, recognizes that pioneering research is necessary, regardless of cost. We also recognize that, since the store of basic research information is being rapidly depleted, more and more pioneering research must be sponsored by an industry which is as competitive as the rubber industry. Ample financial support of pioneering research by industry will be forthcoming even though it offers no more than a gamble of eventually leading to a development project with some hope of being commercialized.

The financial support of applied rubber research and development, as contrasted to pioneering research, is subject to considerably closer scrutiny. This type of research involves an attempt to develop an end-product with definite specifications accomplished either by compounding variations with existing elastomers or by the preparation of a new elastomer. In this case industry will usually finance only those types of applied research where the potential volume of the end-product will provide a return which will cover research and development expenditures. If that return is inadequate, then obviously it is logical to expect that the customer will have to subsidize the research and development charges. If the product is of advantage to the country as a whole, as contrasted to relatively few customers, then it is only reasonable to expect that the entire country, in the form of the government, should pay.

Industry Accomplishments in Pioneering Research

I think everyone realizes that pioneering research, in general, cannot be systematically outlined in advance. It is usually rather expensive, and there is always the probability of no profitable return. Under ideal conditions the various steps in rubber pioneering research involve: (1) the preparation of new and novel elastomers, (2) the characterization and attempts at possible modification of these new elastomers, and (3) based on certain novel characteristics, the development of specific improved end-products. This process was very aptly described by Dr. John Blake in his speech of acceptance of the Charles Goodyear Medal last fall.[7] He said:

"There has been much talk of rubber tailor-made for specific purposes. The picture has been painted of a chemist designing on paper a molecular structure for a particular use and then from this proceeding to make the tailor-made rubber. This is just the opposite of what actually happens. What he really does is to synthesize an ever-increasing variety of rubbers and then test them to see if they are better adapted for a given use than their predecessors. The end-result is the improved special rubber, but it is not a tailor-made product."

The fact that in the past industry has done an outstanding job of research is exemplified by a list of synthetic rubbers which have proved themselves to be profitable to industry and vital to our national welfare. This list includes Thiokol, neoprene, GR-S, nitrile rubbers, Butyl rubber, high styrene elastomers, silicone rubbers, and polyurethane rubbers. The last represents the type of pioneering research which has been carried out by industry at its own expense regardless of cost and is indicative of the type of fundamental and applied research which industry will continue in the future.

Although to many of you this may be ancient history, I should still like to recall some of these projects briefly. They have all followed the same general pattern from fundamental research through final development.

Thiokol

In 1920 ethylene dichloride was reacted with sodium polysulfide while a new anti-freeze was being sought. The product turned out to be a solid, rubbery material, highly insoluble in most organic solvents. As a result of this accidental discovery which suggested interesting possibilities, pioneering research was continued. In 1930, Thiokol was first offered for sale; two tons were produced that year.

Neoprene

This was the earliest successful synthetic rubber of the diolefin type to be produced anywhere in the world. This development was based upon the research of Julius Nieuwland, professor of chemistry at Notre Dame, reported in 1925. Industry recognized the application of this work to the problem of synthetic rubber and took over the research in cooperation with Nieuwland. Neoprene was introduced to the public in 1931.

Nitrile Rubbers

Buna N was originally developed in Germany and patented in the United States in 1934; the American patent rights were acquired by U. S. industry. Buna N was found to be entirely satisfactory to many consumers who had been using neoprene and to new customers as well. Thereafter the demand for Buna N for special high-value uses increased steadily. The nitrile rubbers are definitely specialty rubbers and have been manufactured chiefly by private industry.

Butyl Rubber

The development of Butyl rubber in this country can be traced back as far as 1932 when an industry representative was shown samples of Vistanex while attending a meeting in Germany. Licensing and patent rights were acquired in this country, and in 1935 research on this product led to a rubber-like product whose use was still decidedly limited because it could not be vulcanized. Then in 1937 it was discovered that a small proportion of butadiene could be introduced which permitted cross-linking. At that time there was no market for this new product, but industry still continued its pioneering research. Butyl rubber was first produced in commercial quantities in 1943. It has been revealed that Esso had spent $11,000,000 on Butyl research up to 1948 and has been spending at a more rapid rate since then.

GR-S

The present day GR-S was the result of pioneering research in Germany in the middle 1920's. After World War I interest in synthetic rubbers in Germany lapsed, but when the Stevenson restriction scheme was put into effect in 1925, interest again revived. An improvement in butadiene-derived rubbers was due chiefly to the emulsification process of polymerization which was pioneered by industry in this country and patented in 1927. The German effort to produce a general utility rubber was concentrated on Buna-S, for which the first U. S. patents were issued in 1933. Industry in this country then took cognizance of the importance of this development, and polymerization of diolefins became an active research project. During the years of 1937-1939 licensing and patent agreements were made with the Germans.

[7] *Ibid.*, Nov., 1953, p. 222.

Fig. 1. Akron Government Evaluation Laboratories *(Foreground)* and Pilot Plant *(Rear)*

Shafer Comment on GR-S

Thus, at the time of Pearl Harbor the United States had commercial experience with several types of synthetic rubbers and know-how of the others through laboratory and pilot-plant experience. Representative Shafer, who headed the House Armed Services Rubber Subcommittee, in a speech before an outing of the Manufacturing Chemists' Association,[8] stated that

"Creation of the synthetic rubber industry in the urgent days of World War II was a 'notable' achievement and contributed much to the winning of the war. But I am afraid that there are some persons in and out of Congress who forget or prefer not to remember that it was American industry that made this miracle of rubber production possible. The government, as such, didn't contribute anything except money. I do not underestimate the importance of money, but all the money in the world won't produce rubber without the technical know-how that puts the money to work. Industry contributed the brains; industry furnished the manpower; and industry supplied the patents."

Silicone Rubbers

The development of this series of rubbers is based upon the investigations of Professor Kipping on organosilicon chemistry during the period of 1899 to 1935. It was not until the flexible, heat-resistant high polymers were first produced in the early 1930's that silicons began to approach commercial value. The silicone rubbers, which are outstanding among the various silicone developments, were introduced in 1946 and have provided rubber stocks with wide useful temperature range.

Styrene-Butadiene Copolymers

High styrene copolymers with diolefins, which were introduced several years ago, are now available in the form of latices and solid resins. The resins have been shown to be of particular benefit as reinforcing and processing agents when compounded with both synthetic and natural rubbers.

Hypalon S-2

In 1952, after large expenditures for research and development, Hypalon S-2, a chlorosulfonated polyethylene, became available through industrial research as the result of an attempt to transform polyethylene plastics into curable elastomers. Owing to the desirable combination of properties of this material, progress is being made in adapting this Hypalon rubber for use in tire treads, coated fabrics, footwear, hose, and protective coatings for rubber.

Chemigum SL

During the past year the announcement of new elastomers based on diisocyanate modification of polyesters has disclosed a series of rubber-like products which are superior in some respects to both natural rubber and GR-S. Pioneering research in this field dates back to the early 1940's, when fiber forming materials were obtained by the reaction of polyesters with polyisocyanates. The first rubber-like materials to reach the market resulted from German researches on Vulcollan. A great deal of work has been done in developing uses for these polyester-urethanes. Tire treads show two to five times greater wear resistance than those made from the best cold GR-S. Other potential uses are being investigated.

Other Projects

In addition to the above products completely paid for by industry, there are various projects which have been financed by the Office of Synthetic Rubber whose costs would have been absorbed by industry otherwise, since it was performing the same type of research that it would have done without government support. These include cold GR-S, which gives better tread wear than natural rubber, and oil-extended cold GR-S, which yields a rubber equal to or superior to other types at a lower production cost. This type of rubber, when properly compounded, gives tread wear as good as or better than cold GR-S.

Another project is that of the Alfin polymers, which are still in the pilot-plant stage. In general, the Alfin rubber compounds show superior abrasion resistance, very high flex life, and excellent aging properties.

Pioneering Research Will Be Supported Adequately by Private Industry

I would like now to support my previous statements by quoting a few comments from various industry research people as presented in the last six issues of India Rubber World.[9]

"We need more adequate financial support of basic research together with a real understanding of the nature and importance of basic research. . . . My conclusion is that unless we really understand and properly stimulate basic research, our future progress in applied research, and hence in our industrial economy, will be severely limited."

"The research director of one of our large rubber companies points out that basic research sometimes results from applied research rather than *vice versa* and takes the position that there would be no reduction of effective research from both the fundamental and applied standpoint under private industry. . . . A lot of people seem to think everything develops in a very orderly fashion, going through basic research, after which an applied research program comes along and makes commercial the outcome of the basic research work. In most commercial operations there is a certain amount of art. There are put into commercial processes improvements and new items arrived at, not only from the old art, but from basic research. In other words, the three things become intermingled, and, in fact, to such an extent that the basic research, which teaches what is going on, may even come last."

"Without question, organized industrial research has gone ahead so rapidly in the past decade that the need of fundamental information is rapidly increasing without any corresponding increase in its supply. To some people the only solution has appeared to be government support; others, of which I am one, believe that there is no need or excuse for the government assuming this obligation except that taxes have become so high as to stifle the normal sources of income for the universities, where most

[8] Plastics Division, Manufacturing Chemists Association, Osterville, Mass., Sept. 14, 1953, India Rubber World, Oct., 1953, p. 80.
[9] *Ibid.*, July, 1953, p. 492; Aug. 1953, p. 630; Sept., 1953, p. 775; Oct., 1953, p. 71; Nov., 1953, p. 215; Dec., 1953, p. 358.

of the fundamental research has been done in the past."

"It is quite apparent that in the last few years more and more of the large industrial laboratories have been devoting a portion of their money and efforts to fundamental research. Likewise, many large industrial concerns have been lending support to the university research programs by donating large sums of money for this purpose."

"When plant disposal takes place, the problem of rubber research is a big one. With the plants in private hands, there will no longer be the exchange of information that now exists, under government auspices, between the various industrial contractors in the industry.

"This means that in order to be progressive, more money must be spent than has been spent by RFC. I think the rubber manufacturers recognize this. In my talks with various people on this subject, the best guess that I can make is that after plant disposal the rubber industry will spend between $13 million and $15 million per year on synthetic rubber research. This will be approximately twice the amount spent under RFC auspices.

"In spite of many statements to the contrary, I believe that the rubber industry recognizes, only too well, the role of fundamental research in technical progress. Industry has spent, for years, much time and money in this field. Some of the work has been done in its own organizations, and some has been contracted to universities."

"O. V. Tracy, vice president, Esso Standard Oil Co., said that private industry would spend a good deal more on research than the government has been spending. He estimated that private research expenditures for synthetic rubber would run about $15 million a year, in contrast to the $40 million spent by the government in the 10 years since the program was launched."

"As you are aware, synthetic rubber research sponsored by the RFC has been rather strictly limited to polymers made from butadiene and styrene, and closely related materials. This, of course, is important for the extension of the life of our GR-S types of rubbers, but there has been ample evidence that developments along entirely different lines may, before many years, make these types of rubbers obsolete. Recognition of this fact has caused industrial concerns to do a great deal of work outside the field of interest to the RFC, and I would expect these efforts to be expanded. In the long run the fundamental studies in rubber which have been sponsored by the government are not sufficiently broad to protect the future of industry and the American people for any long period of years. There is no reason, however, why business of this magnitude cannot support an adequate fundamental research program, and I believe that, given an opportunity, industry, aided by and in cooperation with a number of the more active laboratories, will protect the future of the rubber business by an adequate amount of fundamental investigation."

"Undirected investigation, which has often meant rather aimless boondoggling in the government rubber program, will not be continued by industry. However, basic research is a most efficient producer of new knowledge, and so, while the total expenditure for basic work by industry may be less, I would not be surprised if the results were greater."

"I believe that after plant disposal private industry will take over university research that is of good quality, both because it is desirable, and therefore should be done, and because by using the universities they overcome to some extent the manpower limitation. Some of the projects probably will not be taken over, but, on the other hand, I anticipate that new projects will be started. I believe that the rubber industry, in sponsoring university research, will place minimum restriction on such work. Industry will ask only that assignments be made of patentable inventions to the company sponsoring such work. Complete freedom of publication will be permitted after patent requirements are covered."

"I think it would be preferable for the rubber industry to examine the research projects sponsored by the government and for the individual companies to select projects to which they would like to contribute support so that interim government support would not be necessary. This would be an evolutionary step toward including advanced training on elastomers in our university system in a broad way. This, in turn, would insure that the rubber industry will receive a pertinent share of the basic knowledge which flows from the universities, integrated with the contributions from all the fields of interest."

Applied Research and Development for the Department of Defense

Distinct from the case of pioneering research, the sponsoring of applied research by industry will be determined by the potentialities of the end-item. During World Wars I and II weapons systems for the military requirements could be built with materials already available from industry. The main problems of the designer and the construction engineer were selection of the proper material from a wide variety of available materials and the adaptation of it for the particular end-use. At present, and even more definitely in the future, construction of an increasing number of end-items will be based upon materials not as yet available, even in the laboratory. When such materials might also satisfy a potentially large commercial use, industry will support the necessary research and development expenditures. In many cases the potential volume requirement will be so small, or the possibility of a successful outcome so slight, that industry cannot justify attempting to develop such materials at its own expense.

Let us consider now to what extent industry would assume or continue research and development on some of the specific problems which are facing the military branches. Examples of intensive applied research that industry would be willing to assume are not so numerous as in the case of pioneering research.

It is very probable that industry will continue the development of high-performance aircraft tires, because in this case the customer outlet would justify the expenditures for the development of high-temperature rubber stocks, improved cord and fabric designs, etc. The same is true of research on the complete evaluation of tire serviceability because, here again, improved tire performance would be of universal benefit. Research is continuing on the development of better methods of evaluation to decrease the need of long storage-period tests and extensive and costly road-test programs.

The study of the prevention of aging deterioration and

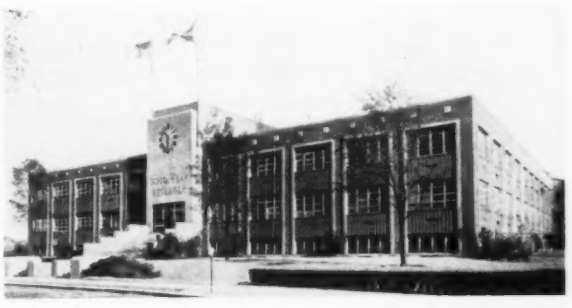


Fig. 2. Goodyear Tire & Rubber Co. Research Laboratory, Akron

the correlation of aging deterioration with continued serviceability is currently receiving a large amount of attention by industry because applied research of this type leads to better life of *all* consumer rubber products.

Research on specific applications of new rubbers such as Butyl rubber, Hypalon, and the diisocyanate rubbers will be continued by the companies directly concerned because the development of new uses for these products would offer possibility of still further customer outlets.

On the other hand, it is questionable whether industry will, with its own funds, undertake applied research and development whose only object is to serve a military need. In many cases only small quantities of specialized elastomers are required for military applications, and it is in these areas that applied research will have to continue as a government responsibility. Military problems which require an end-product with its own set of operational requirements are the type of research whose costs will probably not be absorbed by industry.

For example, one of the chief objectives of the military program continues to be the development of a 100% synthetic rubber heavy-duty tire. Because of the heat build-up factor these large tires still require quite substantial amounts of natural rubber. A great portion of industry's present research is being directed at making improved synthetic rubbers, not necessarily butadiene-styrene copolymers, which would be capable of making such a 100% synthetic rubber tire. Although industry will spend large amounts of money for such pioneering research, it is not likely to spend anything on the attempt to develop such tires from the present GR-S.

Neither would industry be interested in developing new rubbers with a specific goal of use in hose and seals for contact with synthetic lubricants at temperatures from −65 to +400° F. because these conditions are much more severe than would be encountered in general usage. Furthermore, since the end-item outlet would be very restricted, it is not likely that industry would sponsor applied research on such current military problems as (1) elastomers for use in expellant bags in the field of rocket propulsion and for coating protective suits for handling rocket propellants, (2) gaskets for resisting diester fluids and greases, (3) exposure of rubber items to radiation dosage, (4) high polymers for the protection of flight decks of aircraft carriers, (5) flexible deck for recovery of undercarriageless aircraft, (6) dustproof membranes for under airplane landing mats, (7) camouflage for underwater mines for sound detection equipment, and (8) protection of pump impellers from corrosion and erosion.

There are several military problems, however, on which applied research might be conducted by specific companies since the general scope of the project coincides with research which is being currently conducted. These projects include O-rings, rubber lined pipe which can be bent on the job, and elastomers for engine and firewall seals.

Disposition of Government Pilot-Plant

The recent article in India RUBBER WORLD[6] has this to say about the government pilot-plant:

"Many needs of both government and industry will be served by the maintenance and expansion of the present pilot-plant and evaluation facilities operated by the University of Akron. . . . The military services need a pilot-plant for the development and small-scale production of special polymers of a non-commercial character. It would be technically impractical, difficult from the standpoint of security, and prohibitively expensive to undertake to make these special polymers by the use of factory-scale production facilities."

My reaction to this proposal is that, before we recommend disposition of the government pilot-plant, we first ascertain the pertinent facts. The present pilot-plant and evaluation laboratory operated by the University of Akron could function as an organization to furnish pilot-plant facilities to the government and that portion of the future rubber industry which is not now participating in the government program. Since pilot-plant facilities are expensive to establish and maintain, many small firms could take advantage of such a centralized organization, while the military services also could use the facilities for the development and small-scale production of special polymers of a non-commercial character.

It should be kept in mind, however, that, after the sale of the government owned plants, there will be a very large number of polymerization pilot-plants available, since a large number of companies own private pilot-plants, and many of the present government owned plants are also similarly equipped. Consequently the disposition of the government pilot-plant resolves itself into a question as to whether it is, or is not, needed. This information could be acquired by means of a questionnaire which would determine how much annual financial support could be obtained from the small rubber and chemical companies and the Department of Defense. This questionnaire should include a survey of the entire rubber industry in order to obtain definite commitments as to the amount of business which each interested company would guarantee per year. If sufficient money is guaranteed, the operation should be budgeted accordingly.

Under these circumstances a possible suggestion for the future operation of these facilities is that the National Science Foundation take over the supervision of the government pilot-plant, which could be sold to the University of Akron for a nominal sum and be operated by the University for the benefit of private industry and the government. To start up the operation initially, the Foundation could lend such funds to the University as are necessary to staff the laboratories adequately and to maintain and improve the equipment. Under efficient operation these loans would eventually be repaid, since the direct costs of services would be borne by the users. It must be emphasized, however, that such a plan should be considered only if the questionnaire survey indicates that there would be definite commitments by industry and the Department of Defense for the use of the facilities.

Summary and Conclusions

In conclusion, I would like to emphasize once more that in the future, as in the past, the rubber and chemical industries *will* provide the necessary financial support for pioneering research projects, regardless of whether it is possible to determine in advance that the progress will lead to useful results or that the products can eventually be commercialized. The industry will also support those applied research and development projects which might provide end-items whose public or military outlet would compensate for the research expenditure.

Foam Rubber Adhesive

Softseam, a high solids foam rubber adhesive, made with a synthetic polymer, Hydrogene, is available from Anchor Adhesives Corp., Flushing, N. Y., in two forms: No. 1000, for manual application; and No. 1500, for machine or spray application. It is said to have fast grab and to provide a soft, strong seam. The film is crystal-clear.

Butyl Rubber—Manufacture and Research[1]

R. M. Thomas[2]

BUTYL rubber results from a high-speed, continuous, ionic polymerization at —150° F., catalyzed by aluminum chloride and with all ingredients dissolved in methyl chloride.

The aqueous polymer slurry is separated with Oliver filters; unreacted ingredients are recovered; polymer is dried, milled into strips, cooled, and packaged.

Recent research has shown that controlled heating of carbon black-Butyl compounds produces improved dispersion with resulting lower modulus, better resilience, and better electrical resistivity.

THERE is mounting evidence that many future demands for rubber, including its use in tires, might best be filled by Butyl. This rubber is the least expensive of all to manufacture, starting from scratch; it is inherently more stable than other rubbers and therefore more resistant to attack by oxygen or ozone from the atmosphere; it has special properties of interest, such as, impermeability to gases and high tear and abrasion resistance; and, finally, it is less explored than other rubbers and therefore offers a fertile field for development.

The Manufacturing Process

Butyl rubber is made by copolymerizing a cracked refinery gas called isobutylene with a small amount of another material obtained by cracking, called isoprene. The reaction takes place in the presence of a Friedel-Crafts type of catalyst such as aluminum chloride. In commercial plants this reaction is carried out at a temperature of almost 150° below zero Fahrenheit, using liquid ethylene as a refrigerant. Under these conditions the reaction mixture, a clear colorless liquid, is transformed into a snow-white and rubber-like mass within a fraction of a second. The reaction is truly remarkable in that about 10,000 isobutylene molecules scattered at random in the mixture have to line up and join approximately 100 molecules of isoprene which are also scattered about at random. The resulting product is a long thread-like molecule. In the equation in Figure 1 we are illustrating only the general nature of the joining process. We are not attempting to show the actual product of the reaction.

Isobutylene joins to itself in a head-to-tail fashion. Isoprene tends to add in the 1,4 position. As indicated previously, the great speed of this reaction is the chief point of interest. This speed is due to the formation of ions rather than free radicals during the polymerization process. Organic free radicals are electrically neutral groups of atoms having a free valence electron capable

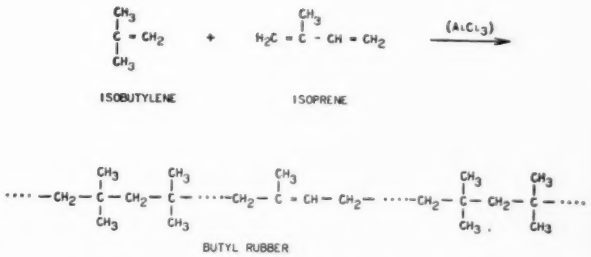


Fig. 1. General Equation for Synthesis of Butyl Rubber

of forming a covalent bond. Organic ions, on the other hand, are groups of atoms having a surplus or a deficiency of valence electrons which therefore possess a negative or a positive electronic charge. Differences between ionic polymerization and free radical polymerization are very striking.

In the commerical production of Butyl rubber, the reactors are five or six feet in diameter and three stories tall. To avoid the difficulty of cleaning out a container of this size plugged with a tough rubbery polymer, we have devised a unique process of making Butyl rubber as a suspension of particles in an inert medium. (See Figure 2.) In this process approximately 2% to 3% of isoprene is mixed with isobutylene. Liquid methyl chloride is added as an inert diluent. This mixture is cooled to a —98° C. Aluminum chloride catalyst dissolved in methyl chloride is added under conditions of good mixing.

The reaction producing the Butyl rubber is a continuous one; fresh feed and fresh catalyst enter the reactor at all times, and they displace a corresponding volume of equilibrium reaction mixture. The polymer forms as a cold slurry of very small particles, which is dropped into agitated hot water where unreacted components are distilled off and recovered for reuse. The rubber that is left behind agglomerates in particles about the size of grains of rice. These particles are kept from sticking together by a coating resulting from zinc stearate, which is added in small amounts to the flash tank water. The rubber is then filtered from the water and put through a series of finishing operations.

A slightly more elaborate flow plan of these operations appears in Figure 3. As mentioned before, isobutylene, isoprene, and methyl chloride are mixed to form a feed blend; the aluminum chloride catalyst in methyl chloride and the feed are mixed together continuously in a refrigerated reactor. Displaced material from the reactor is dropped into agitated hot water, and the unreacted components are vaporized, compressed, dried, further compressed, and distilled. Undesirable impurities, consisting mainly of normal butylenes which tend to accumulate on recycling and a small amount of higher boiling fractions referred to as "bottoms," are purged. Pure methyl chlor-

[1] Presented before the Northern California Rubber Group and The Los Angeles Rubber Group, Inc., on October 1 and 6, respectively.

[2] Esso Laboratories, chemical division, Standard Oil Development Co., Linden, N. J.

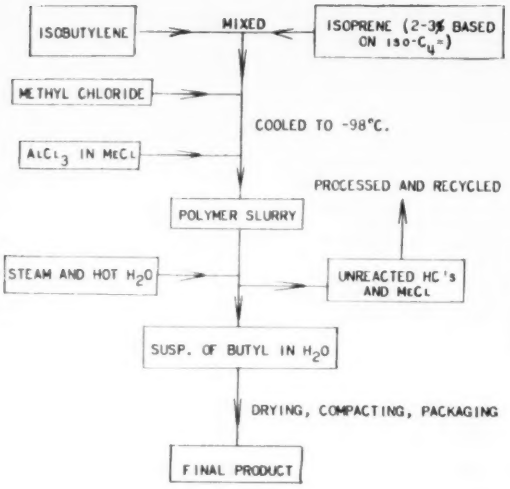


Fig. 2. Simplified Flowsheet of Butyl Rubber Polymerization

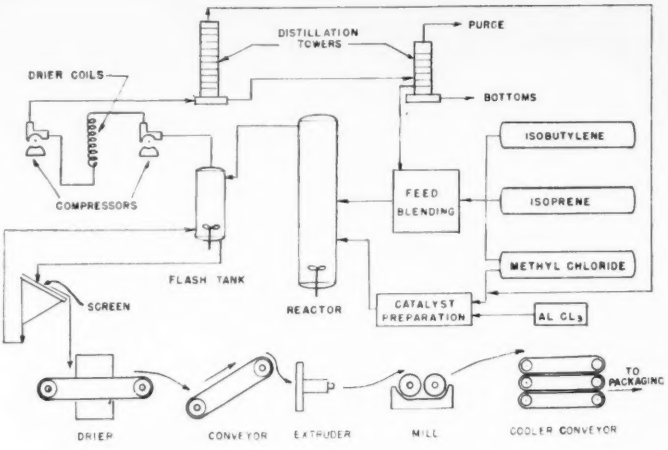


Fig. 3 Plant Flowsheet for Butyl Production

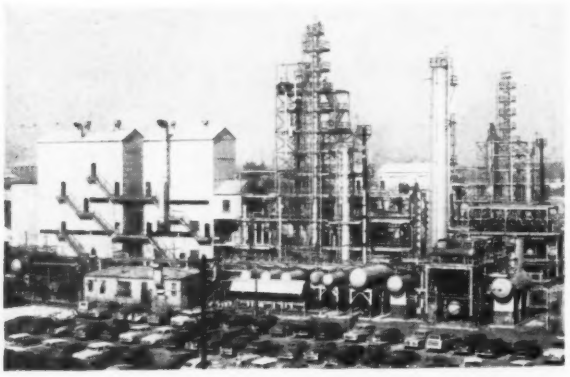


Fig. 4. Overall View of Butyl Plant at Baton Rouge, La.

Fig. 5. Interior of Control Room of Baton Rouge Butyl Plant

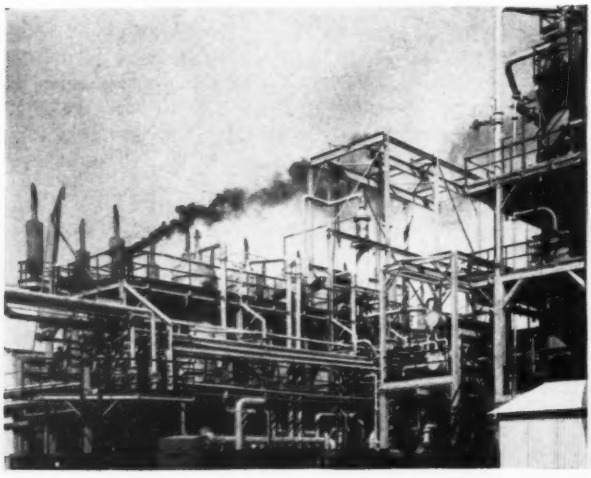


Fig. 6. Partial View of Plant Showing Flash Tank on Extreme Right and Alumina Drying Coils on Left

Fig. 7. In This View, Reactors Are in Left Background and Finishing Building in Right Foreground

ide recovered overhead is used again for catalyst preparation. Dilute feed recycle is returned to the feed blend. This completes the gas recovery part of the operations. Polymer formed as a slurry in the bottom of the flash tank is pumped off to a finishing building where it is filtered off, dried, milled into strips of uniform thickness, cooled, and packaged.

Views of Plant

You might be interested in seeing some of these operations on a commerical scale. The next few illustrations take you on a brief tour of the plant at Baton Rouge, La. Figure 4 is an overall view. Reactors are housed in the tall sheet metal covered buildings in the left background.

Fig. 8. Butyl Polymer Particles Being Separated with Oliver Filter

Fig. 9. Particles Being Spread on Bed of Tunnel Dryer with Screw

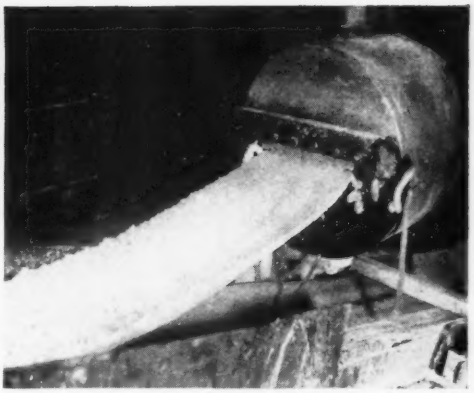


Fig. 10. Extrusion of Butyl Crumb

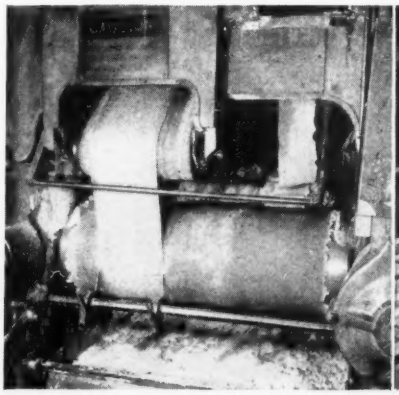


Fig. 11. Hot Milling of Butyl Strip

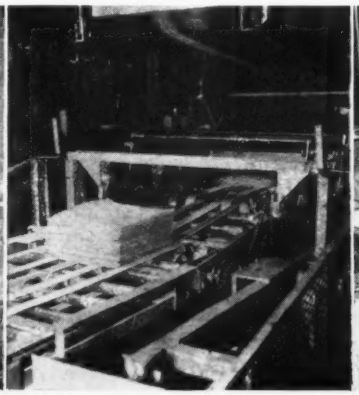


Fig. 12. Squares after Cutting and Stacking

Fig. 13. Packaging of Butyl Rubber

In front is a small brick building which houses the control room. To the right and slightly to the rear are feed blending tanks and gas recovery equipment.

The interior of the control room is shown in Figure 5. The instruments provide control which is essentially automatic. In Figure 6 a part of the flash tank may be seen on the extreme right-hand side. This is a large vessel, measuring 10 feet in diameter and 40 feet in height. Gases taken off overhead are compressed and passed through activated alumina drying coils shown on the left.

In Figure 7, the distance the aqueous slurry of polymer is transported for finishing is indicated since the reactors in the left background are almost a city block away from the finishing building in the right foreground. The slurry is pumped this distance through a two-inch line. Particles of polymer are removed by using an Oliver filter, as shown in Figure 8.

The polymer particles are spread on the bed of a tunnel dryer by a screw, as shown in Figure 9. After drying, the crumb is extruded (Figure 10), hot milled into a strip of uniform thickness (Figure 11), cooled in air by passing it over a long conveyor and then cut into squares by a cutter and stacker (Figure 12). These squares are piled one on the other until the desired weight is accumulated. The stacks move on down a conveyor line and are packaged manually in a thin plastic wrap and boxed for warehousing and shipment (Figure 13).

Research and Development

The discussion which follows on the subject of recent research and development with Butyl rubber is an outgrowth of experimental work on tires made from this rubber. Striking improvements in the properties of Butyl vulcanizates are obtainable by new techniques of compounding and processing that have been developed. The improved vulcanizate is more elastic, tougher, stronger and more resistant to abrasion and attack by certain chemicals. These benefits are obtained by compounding ordinary grades of Butyl with a channel carbon black, followed by heating and mixing prior to the addition of curing ingredients.

Effect of Heat on Stress-Strain

Figure 14 shows the effect of repeated cycles of heating and milling on the stress-strain curve. For each cycle, Butyl containing 50 parts of an MPC black was heated for 30 minutes in open steam at 320° F. and then milled five minutes. The stress-strain curves compare vulcanizates from control masterbackes, which were given no heat treatment and milling, with those which had been subjected to two, four, eight, and twelve cycles of treatment, respectively. Above about 100% elongation, modulus goes up sharply with the first two treatments and then continues to rise as treatments are continued. In the region of lower extensions the curves cross.

At the lower extensions the heat treated material has a lower modulus than the control, and this point is further illustrated in Figure 15. Both strips of Butyl contain 50 parts of MPC black and are identical in all respects except that the sample in the foreground was heat treated prior to curing. The sample in the rear was not heat treated. From Figures 14 and 15 it is apparent that the

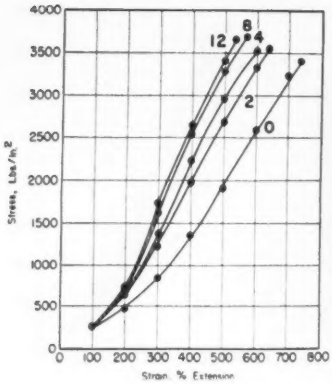


Fig. 14. Effect of Repeated Cycles of Heating and Milling on Stress-Strain Curve for Butyl Rubber

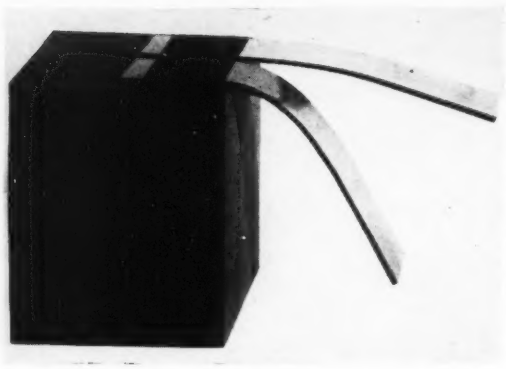


Fig. 15. Lower Modulus of Heat Treated Butyl Strip Evidenced by Sample in Foreground Compared with One Not Heat Treated, in Background

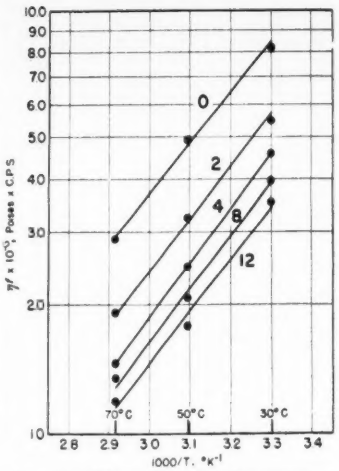
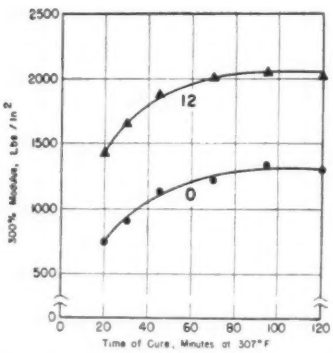


Fig. 16. Effect of Heat Treatment on Hystersis. Internal Viscosity Times Cycles per Second, or Frequency *versus* Reciprocal of Absolute Temperature



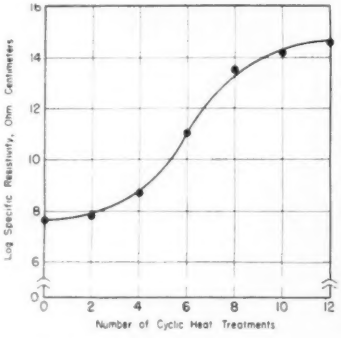


Fig. 17. Modulus *versus* Cure Time for 0 and 12 Cycles of Heat Treated Stock Indicates Increase in Bound Rubber Content Is Independent of Cure Time Since Curves Are Parallel

Fig. 18. Electrical Resistivity Increases with Number of Heat Treatments

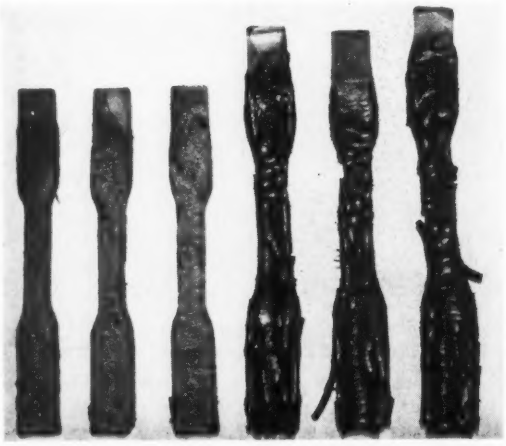


Fig. 19. Further Evidence of Improved Carbon Black Dispersion by Heat Treatment. All Samples Immersed in 96% Sulfuric Acid for 70 Hours. Three Samples on Left Were Heat Treated: Three Samples on Right Were Not

heat treated material is a better rubber because it is more truly elastic.

Hysteresis

Figure 16 shows the extent to which heat treatment lowers hysteresis. A measure of damping is plotted against the reciprocal of absolute temperature. The Greek letter "Eta" represents the internal viscosity, and the "f" the frequency. The product of "Eta" × "f" is proportional to the absolute damping or energy lost as heat per cycle, and the lower the value the more resilient is the compound. A high degree of damping which decreases rather sharply with increase in temperature is observed for the control compound. With repeated cycles of heat treatment, all of these values get lower and lower.

Dispersion of Black

Changes brought about by the heat treatment are also attended by an increase in bound rubber content. The effect, as measured by 300% modulus, is independent of the state of cure since the curves for 0 and 12 cycles of heat treatment are parallel. (See Figure 17.) We do have indications that heat treatment improves dispersion of the carbon black.

Figure 18 shows a marked increase in electrical resistivity as the result of cycling heat treatments. Increased resistivity is attributed to a breaking up of conducting chains of black. It is of interest that the most rapid increase in resistivity takes place after the greatest change in other properties previously considered. Increases in modulus (Figure 14) were most striking after two cyclic treatments; whereas for resistivity the change is most rapid after four treatments. This point suggests a mechanism whereby Butyl is first bonding to agglomerates of black, thereby increasing modulus, etc., and then the anchored agglomerates of black are broken up to produce a better dispersion.

Additional evidence that the interaction process, as we call it, is giving better dispersion appears in Figure 19. These samples were all immersed into 96% sulfuric acid for 70 hours at room temperature. The three on the right were controls. The three on the left are identical in composition, but were heat treated. The greater swelling and disintegration of the controls suggests a less adequately dispersed condition of carbon black, which probably served as a wick to take up acid.

Heat Treatment with Furnace Blacks

In conclusion, we should point out the importance to the interaction process of chemisorbed oxygen on the surface of the black. The process works well as described for channel blacks or for oxidized furnace blacks. It does not work for ordinary grades of furnace black which are relatively free of oxygen on the surface. Such furnace

(*Continued on page 213*)

Air Permeability of Elastomers by Diffusion Tests[1]

M. Czuha[2]

THE permeability of various tread-type compounds made from natural, GR-S, and Butyl rubbers measured in a modified Warburg diffusion apparatus gave values ranging from low for Butyl, intermediate for GR-S, to high for natural rubber.

Permeability decreased with increasing combined styrene contents and with a decrease in polymerization temperature for polybutadiene and low styrene copolymers. Mooney viscosity, gel content, and dilute solution viscosity had no effect.

Increased cure time and carbon black content decreased permeability. Increased 300% modulus also decreased permeability.

THE various techniques developed for the measurement of the permeability of elastomers to gases involved either an absorption[3] or a flow measurement.[4] A manometric flow method developed by The B. F. Goodrich Co.[5] utilized a modified Warburg apparatus[6] commonly used in biological studies to measure small amounts of gases evolved and absorbed by tissues. The apparatus was modified by replacing the respiration flasks with diffusion cells. The direct measurement of the amount of gas passing through a polymer specimen of convenient size and thickness in a relatively short time makes this technique attractive from the standpoint of simplicity of operation. Since little data have been reported in the literature on loaded stocks, the purpose of this study was to examine the merits of this test as applied to tread-type vulcanizates.

Equipment and Procedure

The diffusion apparatus is a modified Warburg unit (Figure 1) in which the respiration flasks are replaced by diffusion cells connected to a gas manifold. Six diffusion cells (see Figure 2), each connected to a manometer, are immersed in a water bath, the temperature of which is usually maintained at 30 ± 0.1° C. The rate of diffusion is observed as the displacement of liquid in the arm of the manometer connected to the downstream side of the diffusion cell and separated from the gas under pressure by the polymer. A 60-psi. pressure gage is used to measure the pressure of the gas in the manifold; the pressure applied in the test is 48 psi. A leveling device permits manometer readings at atmospheric pressure which is indicated by a standard mercurial barometer. The temperature of the room is maintained at 25° C. The liquid (Brodie solution) in the manometer is an aqueous salt solution (sp. gr. 1.028) containing a red dye. The manometer factor (approximately 2 mm.[3] per mm. of displacement) is determined for each manometer by weighing the mercury that is found to occupy a measured length of capillary in the manometer.

The diffusion cell is constructed of two circular, recessed stainless-steel plates between which the test piece is clamped. A porous Alundum disk on one side of the cell serves as a support for the polymer specimen. The connection between the cell and the manometer is a stainless-steel capillary tube, with an internal diameter of approximately 0.025-inch. The coupling is filled with lead and drilled to reduce the downstream volume, which is approximately two milliliters. The total volume of gas

[1]This work was performed as a part of the research project sponsored by the Reconstruction Finance Corp., Office of Synthetic Rubber, in connection with the government synthetic rubber program.
[2]University of Akron, Government Laboratories, Akron, O.
[3]A. S. Carpenter, D. F. Twiss, *Ind. Eng. Chem. (Anal. Ed.)*, 12, 99 (1940).
[4]H. A. Daynes, *Proc. Roy. Soc.*, A97, 286 (1920).
[5]Private communication from A. W. Carpenter, B. F. Goodrich Co., to B. G. Labbe, University of Akron, Government Laboratories (Feb. 6, 1952).
[6]M. Dixon, "Manometric Methods," Macmillan Co., New York (1934).

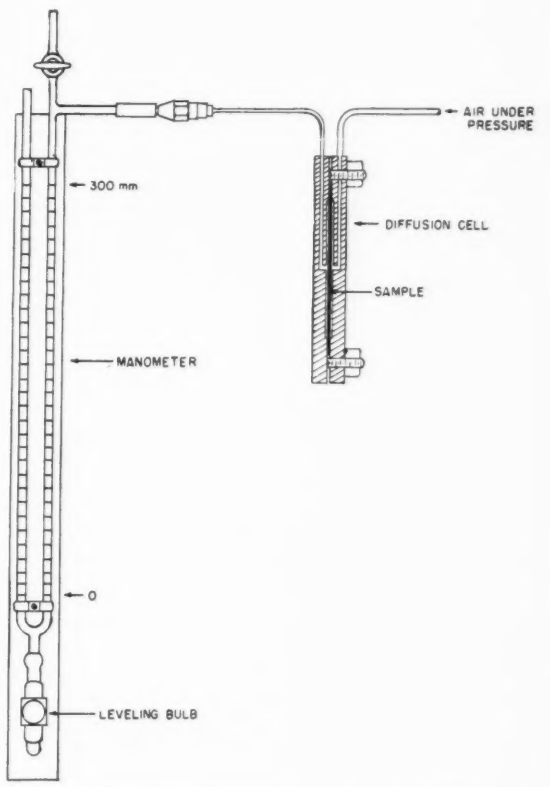


Fig. 1. Schematic Drawing of Modified Warburg Diffusion Apparatus

Fig. 2. Six-Unit Diffusion Apparatus in Controlled Temperature Water Bath.

diffusing through the cell during the test is of the order of one milliliter. The dimensions of the diffusion region within the polymer are 12.57 square inch area and 0.025-inch thickness; the average thickness is obtained by gaging the polymer at five positions, using a Randall and Stickney gage.

An equilibration period of three hours after loading is required to reach a steady rate of diffusion, at which time the rate of diffusion is measured every five minutes for 30 minutes. A repeat test is then conducted for an additional 30 minutes, and the amounts of gas diffused during both periods are added to give the total manometer reading in millimeters per hour. In general, the agreement between the two 30-minute readings was 1% or less.

The permeation coefficient or permeability, Q, at steady state diffusion[4] is given by the equation:

$$q = Q \frac{A \times t \, (p_1 - p_2)}{d} \qquad (a)$$

By rearrangement,

$$Q = \frac{qd}{A \times t \, (p_1 - p_2)} \qquad (b)$$

where q = volume of gas diffusing through polymer.
d = thickness of the polymer specimen.
A = area of the polymer surface.
t = time of diffusion.
p_1 = pressure on the surface of the polymer incident to the diffusing gas.
p_2 = pressure on the downstream surface of the polymer.

In terms of data collected in the laboratory, equation (b) can be rewritten in the units as shown:

$$Q = \frac{M \times F \times B \times d}{P} \times 2.97 \times 10^{-7} \qquad (c)$$

where M x F = q in equation (b)
M = manometer reading, mm./hr.
F = factor for converting unit manometer readings to cubic millimeters.
d = thickness of the polymer, thousandths of an inch.
P = $(p_1 - p_2)$ in equation (b), is the pressure drop across the polymer, psi.
B = atmospheric pressure, in Hg.

The factor 2.97×10^{-7} times B includes the following conversion factors: the volume of the gas from mm.^{3} to ft.^{3}, the area of the disk from in.^{2} to ft.^{2}, the time from hours to days, and corrects the volume of gas to standard conditions of temperature and pressure (32° F. and 29.92 in. Hg.).

Permeability is thus defined as the number of cubic feet of air (at 32° F. and 29.92 in. Hg.) diffusing through 0.001-inch thickness of polymer under a pressure differential of one psi. per square foot of polymer per day.

Accuracy and Reproducibility

The accuracy of the measurements in absolute units was uncertain, since no other test was available for checking the results. However, the present values reported for the permeability of natural rubber compounds are in good agreement with those for natural gum vulcanizates determined by others,[7, 8] when allowance is made for the effects of carbon black loading and variations in cure.

The reproducibility of the air-diffusion tests was determined on a standard control copolymer, 41° F. GR-S-1500, 75/25 BD/S (X-672). The average of 20 measurements was 3.4×10^{-3} with an average deviation of

[7] G. J. van Amerongen, *Rubber Chem. Tech.*, 24, 109 (1951).
[8] A. S. Carpenter, *Trans. Faraday Soc.*, 43, 529, 822, (1947).

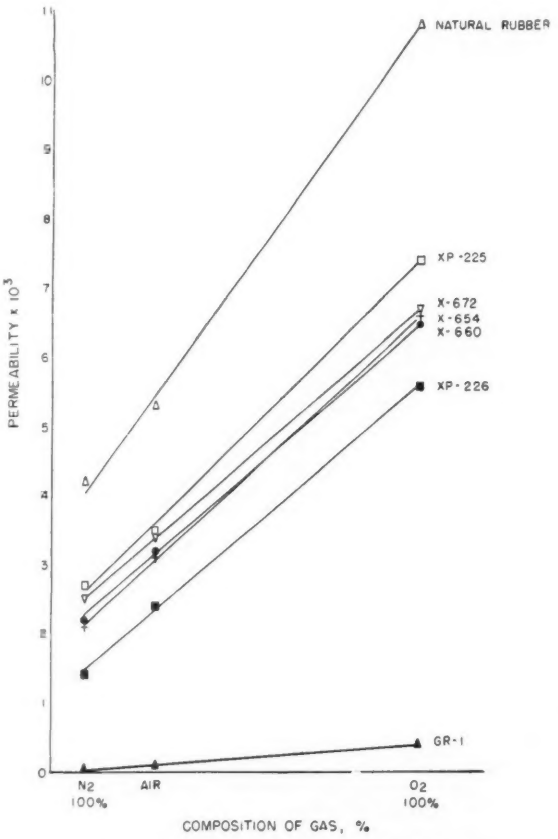


Fig. 3. Permeability of Several Polymers to Various Gases

0.06 x 10^{-3}. The values ranged from 3.3 to 3.6 x 10^{-3}. The determination of the thickness of the polymer was the least accurate part of the diffusion test. Although it was possible to measure the thickness at any given point to 0.001-inch, it was difficult to cure disks of uniform thickness at every point, and variations as high as 0.006-inch occurred across the disk.

Typical Results

Table 1 lists some of the polymer types and compounding recipes used in this study. The specimens to be tested were cured 10 to 15 minutes longer than the optimum cure, selected on the basis of the 300% modulus values, except where measurements over a range of cures were desired. All the compounds were cured at 292° F. with the exception of natural rubber and Butyl compounds, cured at 280 and 307° F., respectively.

TABLE 1. POLYMER TYPES AND COMPOUNDS USED

		Compounding Recipe
1.	Natural rubber	A
2.	GR-I	B
3.§	X-603, 71.5/28.5 BD/S	C
4.	23HPA Bld, 72/28 BD/S, high gel copolymer prepared at 122° F.	C
5.	GR-S-1008, 72/27.5/0.5 BD/S/DVB prepared at 124–127° F.	F
6.	X-672, 75/25 BD/S, prepared at 41° F.	D
7.	40H K3-6 Bld, 75/25 BD/S, prepared at 41° F.	E
8.¶	XP-225, 75/25 BD/S, prepared at 41° F. and masterbatched with 45 parts Circosol-2XH	I
9.	XP-226, 75/25 BD/S, prepared at 41° F. and masterbatched with 45 parts Dutrex 20	I
10.	XP-169, polybutadiene prepared at 14° F.	D
11.	IZ Bld 20, polybutadiene prepared at 122° F.	D
12.	XP-193, 95/5 BD/S prepared at 122° F.	D
13.	XP-203, 85/15 BD/S prepared at 122° F.	C
14.	XP-205, 90/10 BD/S prepared at 14° F.	D
15	XP-204, 75/25 BD/S prepared at 14° F.	D
16.	78PC29 Bld 2, 75/25 BD/S sodium catalyzed	H
17.	60E18 Bld 32, 75/25 BD/S Alfin	G
18.	60E18 Bld 33, 75/25 BD/S Alfin	G

COMPOUNDING RECIPES

	A	B	C	D	E	F	G	H	I
Polymer	100	100	100	100	100	100	100	100	100
Oil	—	—	—	—	—	—	—	—	45
EPC black	40	50	40	*40	40	40	40	40	72.5
Zinc oxide	5	5	5	5	5	5	5	5	5
Sulfur	3	2	2	2	2	2	1.5	2	2.64
Altax†	—	0.5	1.75	3	2.35	2	2.25	1.25	3
Captax†	0.5	—	—	—	—	—	—	—	—
Methyl tuads†	—	1	—	—	—	—	—	—	—
Stearic acid	3	3	—	1.5	0.75	1.5	—	3	1.5
PBNA‡	1.5	—	—	—	—	—	—	—	—

*10, 20, and 60 parts were also used in the study of the effect of carbon black (X-672).
†R. T. Vanderbilt Co., New York, N. Y. §Sun Oil Co., Philadelphia, Pa.
‡Phenyl beta naphthylamine. ¶Shell Oil Co., New York.

Stress-strain tests were conducted in accordance with the standard procedure of the Office of Synthetic Rubber.

Gas Composition

Figure 3 shows the permeability of several polymers as a function of the gas composition. The permeability to nitrogen, air, and oxygen of 75/25 BD/S copolymers (XP-225 and XP-226) prepared at 41° F. and masterbatched with two types of processing oil is compared with values for non-oil X-672, natural rubber, and GR-I. The linear relation of the data indicates that the permeability of a polymer is an additive property for mixture of gases. The greater permeability of a given polymer to oxygen than to nitrogen is attributed to the smaller molecular diameter and greater solubility of oxygen in the polymer.[8] The nature of the processing oil also has some effect on the permeability. Circosol-2XH appeared to increase slightly the permeability of copolymer prepared at 41° F. even with the increased carbon black loading (XP-225). Masterbatching with Dutrex 20 decreased the permeability of copolymer prepared at 41° F. (XP-226). Although the permeability is affected to a slight degree by the nature of the oil, the change is insignificant when compared to the variation with polymer type; the GR-S type polymers have a lower permeability than has natural rubber, but higher than GR-I polymer.

Polymer Composition and Structure

TABLE 2. EFFECT OF STYRENE CONTENT ON AIR PERMEABILITY

Polymers	Compounding Recipe	Combined Styrene* %	Time of Cure at 292° F. Min.	Permeability † x10^5
Polybutadiene (1Z Bld 20), 122° F.	D	Nil	60	7.0
95/5 BD/S (XP-193), 122° F.	D	5.0	45	6.5
85/15 BD/S (XP-203), 122° F.	C	12.4	50	5.2
(X-603) 71.5/28.5 BD/S 122° F.	C	23.5	55	3.3
Polybutadiene (XP-169), 14° F.	D	Nil	45	6.1
90/10 BD/S (XP-205), 14° F.	D	9.6	50	4.7
75/25 BD/S (XP-204), 14° F.	D	21.0	50	3.3

*By the refractive index method.
†Cubic foot of air (at 32° F. and 29.92 in. Hg.) diffusing through 0.001-inch thickness of polymer under a pressure differential of one psi. per square foot of polymer per day.

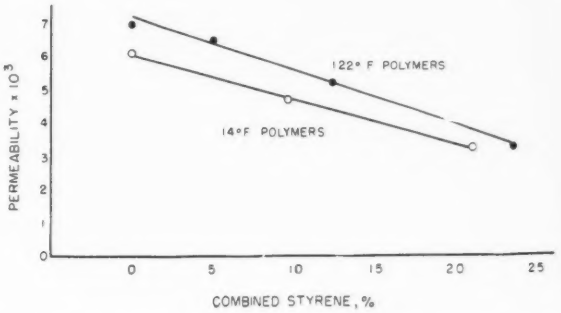


Fig. 4. Effect of Styrene Content and Polymerization Temperature of BD/S Copolymers on Air Permeability

The effects of composition and structure on the permeability of the polymer, as evidenced by results of the effects of combined styrene and polymerization temperature are shown in Figure 4. According to the corresponding data presented in Table 2, an increase of 10% in combined styrene resulted in a 23 to 36% decrease in permeability. The permeability was less for polymers prepared at low temperature than for those at high temperature. This effect was greatest for polybutadiene and copolymers of low combined styrene contents. Apparently a polymer structural influence on permeability, dependent on the temperature of polymerization, resides in the butadiene part of the polymer molecule.

Mooney Viscosity

The effect of Mooney viscosity of the base polymer on the permeability of the vulcanizate was investigated over the range of 61 to 150 ML-4, for a GR-S-1500 75/25 BD/S copolymer. Tests A and B were made on duplicate samples of compounds containing 40 parts of EPC black and cured for 50 minutes at 292° F. The results in Table 3 indicate that there is no significant variation in permeability with ML-4 viscosity of the base polymers.

TABLE 3. EFFECT OF MOONEY VISCOSITY ON THE AIR PERMEABILITY OF 75/25 BD/S COPOLYMERS PREPARED AT 41° F.*

Polymers	Viscosity ML-4	Combined Styrene† %	Permeability‡ x10⁸ Test A	Test B
40HK3-6 Bld	61	19.3	3.6	3.7
7F1-M	90	19.7	3.6	3.6
5F2-M	120	19.1	3.5	3.5
1F2-M	150	21.7	3.5	3.8

*Compounding recipe E used throughout, with time of cure at 292° F., 50 minutes.
†By refractometer calibrated for 122° F. GR-S copolymers.
‡See footnote†, Table 2.

Gel Content and DSV

The gel content and dilute solution viscosity of the base polymers appear to have no relation to the permeability of X-603, GR-S, and GR-S-1008 vulcanizates. The data in Table 4 show a slight variation in permeability which probably is the result of differences in combined styrene content.

TABLE 4. EFFECT OF GEL CONTENT AND DSV ON THE PERMEABILITY OF POLYMERS

Polymer	BD/S/DVB	Gel %	DSV	Compounding Recipe	Combined Styrene %	Time of Cure at 292° F. Min.	Permeability‡ x10⁸
X-603	71.5/28.5/0	3	2.21	C	23.5	55	3.3
23HPA Bld. (122° F.)	72/28/0	65	0.75	C	27.6	45	3.1
GR-S-1008	72/27.5/0.5	81	0.55	F	22.9	50	3.4

‡See footnote†, Table 2.

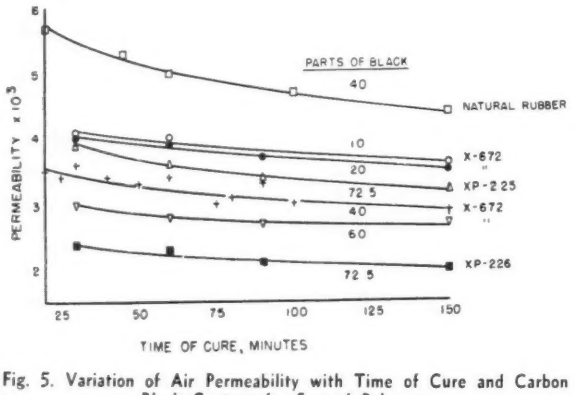


Fig. 5. Variation of Air Permeability with Time of Cure and Carbon Black Content for Several Polymers

Cure and Carbon Black

Figures 5 and 6 show an almost linear dependence of permeability on time of cure and carbon black loading. The curing time was varied from 30 to 150 minutes for natural rubber, X-672, XP-225, and for XP-226.

300% Modulus

The permeability of a given polymer is related to the 300% modulus as shown in Figure 7. An increase of 100 psi. in modulus was accompanied by a decrease of approximately 2% in permeabiilty to air. Curves are shown for natural rubber, GR-S type copolymers, and sodium and Alfin copolymers. The GR-S type copolymers included X-672 (75/25 BD/S prepared at 41° F.), X-603 (71.5/28.5 BD/S prepared at 122° F.), 23HPA Bld (72/28 BD/S, high gel polymer prepared at 122° F.), GR-S-1008 (72/27.5/0.5 BD/S/DVB), and XP-204 (75/25 BD/S copolymer prepared at 14° F.). Apparently there is a reversion in the curve for natural rubber in the region of overcure as shown in Figure 7 by the dotted line. The variations in the modulus of natural rubber and sodium and Alfin polymers were

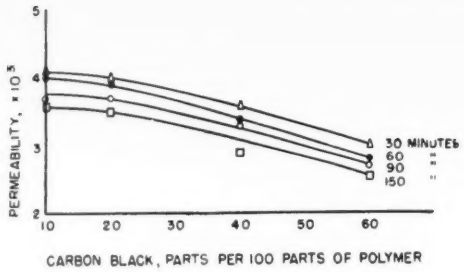


Fig. 6. Variation of Air Permeability of 41° F. BD/S Copolymer with Black Content at Various Cures

obtained by varying the time of cure. The extended range in modulus for the GR-S type copolymers was effected by varying both the time of cure and carbon black loading of X-672.

Summary and Conclusions

The permeability of various tread-type compounds to air was measured in a modified Warburg diffusion apparatus. Measurements were made at 30° C. with air applied at 48 psi. pressure on molded disks approximately 0.025-inch thick and an area of 12.57 square inches. The tests were reproducible within 4% on control specimens. The compounds investigated showed permeabilities intermediate between the low values for Butyl and the high values for natural rubber.

The permeability decreased with increasing combined styrene contents and with a decrease in temperature of polymerization for polybutadiene and low styrene copolymers. It was unaffected by variation over a large range in polymer Mooney viscosity, gel content, and dilute solution viscosity.

A slight and almost linear decrease in permeability was found with increases in time of cure and carbon black loading for the stocks. In terms of the 300% modulus, an increase of 100 psi. was accompanied by a 2% decrease in permeability. Processing oil in the polymer had only a slight effect on permeability, when compared to the effects of compositional and structural modifications. Alfin and sodium, 75/25 BD/S, copolymers showed the lowest air permeability of the tread-type compounds that were studied.

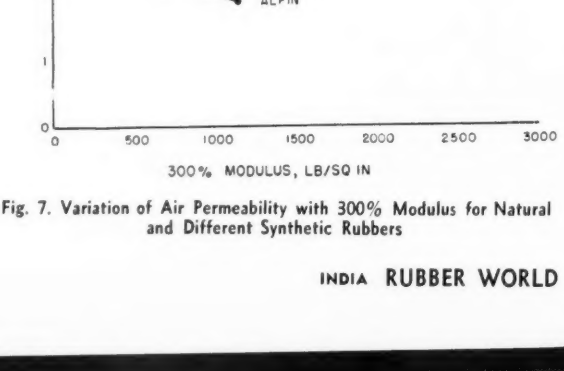


Fig. 7. Variation of Air Permeability with 300% Modulus for Natural and Different Synthetic Rubbers

Depolymerized Rubber—100% Rubber in Flowable Form

Henry Pande[1]

D P R, depolymerized natural rubber, is available in a standard low-viscosity and a standard high-viscosity grade for use in cured or uncured form.

Another special grade for mixing with materials such as asphalts and polyethylene is also available.

D P R may be compounded in the usual manner and is compatible with many resins to provide material for special applications where its ability to be applied and shaped by either spreading or casting is of major importance.

NATURAL rubber in flowable form and with 100% rubber solids content has been described in the literature numerous times since the turn of the century (1-34).[2] In recent years certain practical uses have been publicized (35). As a result, a more uniform raw material suitable for more widespread use has been developed.

D P R[3] is crude natural rubber in depolymerized form. The depolymerization and liquefaction are accomplished by subjecting the natural rubber to a rigidly controlled thermochemical process which provides a flowable rubber with a uniformly reproducible viscosity. The standard low-viscosity D P R has about the consistency of molasses at room temperature. (See Figure 1.) A higher-viscosity material is also available.

In application, D P R is used in both the uncured and cured states. In the former it is added to resins, rubber, waxes, plastics, and low-melting point asphalts, as a plasticizer, and it is also used as an additive for pressure-sensitive tapes. In the cured state D P R is used in the cable industry in the form of potting compounds: it may be used for "flowed-in" gaskets and in numerous other applications where its ability to be applied and shaped by either spreading or casting is of major importance.

In addition, there is another form of D P R approximating the physical appearance of the regular high-viscosity grade. This special grade is modified in such a way that it is highly compatible with materials such as, asphalts, Gilsonite, and polyethylene.

Properties

The viscosity is basically a function of the molecular weight of the depolymerized rubber, at any given temperature. Low-viscosity D P R has a molecular weight of about 7,000, and the high-viscosity grade, a molecular weight of about 11,000, as determined by the light scattering method.

Other properties common to both grades are as follows: ash, 0.5-1.2%; volatile matter, 0.1% (24 hours at 300° F.); specific gravity, 0.92 at 25° C.; color, light brown in thin film; storage stability, chemically and physically stable in covered drums at room temperature for years.

The viscosity of the low-viscosity grade is about 12,000 cps. at 150° F., and that of the high-viscosity grade is about 65,000 cps. at 150° F. These results were obtained using the Brookfield Synchro-Lectric viscosimeter.

Processing

Mixing and compounding with D P R may be done in comparatively lightweight mixers. If open churns are used, the stirrers should be reduced in speed. Dough mixers of the Hobart type may also be used satisfactorily. Two-roll open mills are not suitable.

All dry pigments, such as sulfur and zinc oxide, should be sifted before being added to the D P R. If only a small amount of pigment is to be added, it should be mixed with a part of the D P R to form a masterbatch, and the remainder of the D P R, together with any liquid compounding ingredients, added after good dispersion of the pigments has been obtained in the masterbatch.

Many resins may be added best to D P R by mixing at a temperature high enough to liquefy the resin. Velsicol,[4] cumar, and Staybelite[5] resins may be compounded with D P R in this manner. Staybelite resin imparts cohesive tack to the mixture. When compounded at the

[1] Laboratory of D P R, Inc., a subsidiary of H. V. Hardman Co., Belleville, N. J.

[2] Numbers in parentheses refer to Bibliography items at end of this article.

[3] Registered trade mark.

[4] Velsicol Corp., Chicago, Ill.

[5] Hercules Powder Co., Wilmington, Del.

Fig. 1. Pouring P R from Shipping Container

(Right)
Fig. 2. Metering Pump by E. E. Robinson for Handling D P R

melting points of the resins, the D P R-resin mixtures are quite fluid and may be handled in a specially designed, electrically heated, gear-driven metering pump.[6] (See Figure 2.)

D P R has the ability to wet large amounts of clay, silica, or blanc fixe and still remain flowable for casting or spreading. The guanidines are very satisfactory as accelerators. Bardol[7] in amounts of about 10 parts on 100 of D P R not only accelerates the cure, but also provides a good covulcanizing plasticizer. Pulverized quicklime (calcium oxide) (24) prevents porosity during the hot air cure at atmospheric pressure used for most D P R stocks. A basic D P R compound would be as follows:

D P R	100
Bardol	10
Clay or silica	50–90
Calcium oxide	10
Sulfur	1–50
DPG (diphenylguanidine)	1

The curing time and temperature, final hardness, and the specific properties of the compound will be developed by the compounder by the types and amounts of fillers, accelerator, and sulfur used.

As a vulcanizable softener for natural rubber, the substitution of 10 parts of D P R for 10 parts of the natural rubber on the mill decreases breakdown time with little loss of tensile strength and modulus of the vulcanizate. In this application the D P R acts as a vulcanizable, non-extractable plasticizer.

Low-viscosity D P R may be added to latices to increase the total solids content and provide films with increased tack before cure. The addition of 10-50% D P R to Revertex provides a blend that will remain stable for months.

Hard rubber prepared from D P R compounds has properties similar to those of press molded hard rubber. D P R hard rubber is strong enough to serve as a bonding agent for hard rubber bonded grinding wheels.

Soft rubber from D P R compounds does not have the tensile strength and other physical properties obtained with conventional mixes, and this factor limits the applications of D P R soft rubber compounds to places where these properties are not essential.

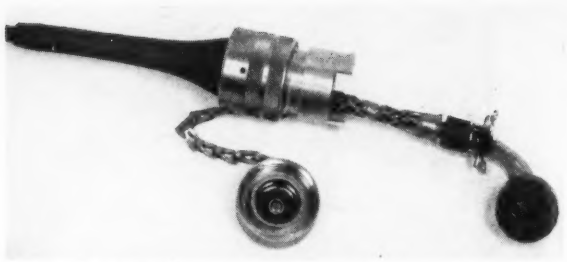
Some potting compounds must be soft, resilient, and free from shrinkage. Such compounds made with D P R may be poured in place and cured either by standing at room temperature or by application of heat. There is good adhesion to most materials and no shrinkage to cause objectionable voids. There is no water evolved during cure, and electrical properties of the film are usually good.

#46 Permo Compound

The #46 Permo Compound has found use in the cable industry for potting various types of cable connectors. (See Figure 2.) This compound will cure at room temperature or higher and does not become brittle at –67° F. or fluid at 220° F. It is supplied in two parts, one of which contains the curing ingredients, and the other the D P R. Maximum storage stability is insured by the use of this two-part system, and the shelf life of the components has been found to be well over a year at room temperature.

After the two parts have been mixed as directed, the material has a pot life at room temperature of from three to seven days.

The #46 Permo Compound is representative of one of the softest vulcanizates. The addition of more sulfur and fillers produces rubbers of increased states of firmness.



U. S. Army Photograph

Fig. 3. Spiral Four-Connector Manufactured by United States Rubber Co. Uses D P R #46 Permo Compound for Cementing Cable and Connector Parts

The physical properties of #46 Permo Compound are as follows: viscosity, molasses-like liquid; cured hardness (Shore), 5; color, grey; specific gravity, 0.98; pounds per gallon, 8.2.

The electrical properties of this compound were determined by the Electrical Testing Laboratories of New York.

Volume Resistivity at 25° C.
3.8×10^{13} ohm cms.
1.5×10 megohm inches.

Dielectric Constant

° C.	60 Cycles/Sec.	1000 Cycles/Sec.
25	3.2	2.8
50	3.1	2.8

Dielectric Strength (Short-Time Puncture)
57.5 KV on 315-mil sample
Average volts per mil—185

Dissipation Factor

° C.	60 Cycles/Sec.	1000 Cycles/Sec.
25	0.0050	0.0047
50	0.0086	0.0080

Applications

Troweling compounds for use where the coating must not sag from vertical walls during vulcanizing are made by compounding D P R with Silene E. F.[8] and carbon blacks.

The addition of Shawinigan[9] 100% compression acetylene black to D P R provides much higher electrical conductivity than similar additions to milled crude natural rubber batches. There is better contact maintained between the particles of conducting black in the low-viscosity D P R mix than there is with regular crude natural mixed and standard rubber mill and where each particle of black is more nearly insulated with rubber. Troweled and vulcanized radiant heating panels have been produced in the laboratory with D P R and acetylene black. Both hard and soft rubber compounds with controllable resistance and conductivity have shown promise for cable fillers and for use as static eliminators.

When properly used, semi-conductive D P R is useful in high-frequency cables to supplement metallic shielding. The D P R may be applied in thin continuous layers as a 100% solids material and vulcanized immediately. The physical properties of semi-conductive D P R approach those of the dielectric, and its electrical properties approach those of the metallic conductor or shield. The material may be used for any of the three fundamental purposes of shielding for electric fields—to confine disturbances within the dielectric to the cable itself, to confine the electric field to the primary dielectric, or to reject external disturbance from the electric field in the dielectric.

[6] Edward E. Robinson, Inc., 95 Park Ave., Nutley, N. J.
[7] Barrett Division, Allied Chemical & Dye Corp., New York, N. Y.
[8] Columbia-Southern Chemical Corp., Pittsburgh, Pa.
[9] Shawinigan Chemicals, Ltd., Montreal, P.Q., Canada.

Quick-curing D P R stocks may be formulated for "flowed-in" gaskets. The addition of D P R to spreader stocks raises their solids content and reduces the amount of volatile materials to be removed before curing. D P R is used in car undercoaters, calking and sealing compounds. Additions of this compatible form of rubber modify many resin systems to impart desirable rubbery characteristics, especially if cured.

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Butyl Rubber

(Continued from page 206)

blacks require the use of special promoters. Papers giving the details of all of this work have been published.[3] The practical aspects of conducting a Butyl rubber-carbon black interaction on a factory scale will be discussed in a paper by W. H. Peterson, Enjay Co., Inc.[4]

[3] *Rubber Age, (N. Y.)*, 74, 59-71, 243-51, 397-408 (1953); 74, 561-67 (1954).
[4] To be published in India RUBBER WORLD, June, 1954.

Holofol Process for Tubular Articles

NEW details of the Holofol process[1] for tubular articles recently appeared in *Kautschuk Anwendungen*,[2] the publication put out by the German branch of Rubber Stichting, Delft, Holland.

This German process, it may be recalled, permits the manufacture of seamless, hollow goods of the most varied types, from a single sheet of calendered rubber. The rubber is completed, and, except for the air valve, emerges as a pose; it is calendered to a thickness slightly less than the combined thickness of two sheets usually employed for the article to be made, and the desired shape is stamped or cut out, with or without a valve seat.

The unvulcanized shape is then put on a conveyor belt at the opening of the Holofol installation and passes through successive processing baths. The first is a water solution, which acts on an electrolytic basis in the presence of vulcanizing agents, and the passage through it occurs at a temperature of 80 to 100° C., and takes 20 minutes, for a sheet one millimeter thick. The shape is next washed in water alone and then treated in a bath containing a predetermined amount of a swelling agent harmless for rubber. The shape, still a single sheet, now passes through an electrical heating zone; the swelling agent, which has penetrated the stamped sheet on all sides, causes a separation of the material at the exact core of the sheet, that is in the center of the sheet and also at a distance of half the thickness of the sheet at the cut edges. This separation is caused by gasification of the swelling agent, resulting in excess pressure in the interior of the material, and consequent inflation of the body to a bulging, completely seamless, hollow structure. The separation at the core of the sheet can be regulated so that dimensional tolerances can be held to extremely low values and in no case exceed the usual tolerances for articles molded in the conventional manner. The fully inflated, hollow body now passes through a final zone, where vulcanization is completed, and, except for the air valve, emerges as a finished product requiring only to be powdered, if needed.

What seems to happen during the process is that the object undergoes vulcanization on all sides except at the core, which retains an unvulcanized zone; it is here that the separation takes place due to inflation caused by formation of gas as a result of the action of the heat waves, to form the hollow seamless articles.

The method is claimed to be surprisingly precise, resulting in a minimum of rejects, far fewer in fact than with the usual processes. With it, from 10 to 30% less rubber is needed: the manual work required is cut by half, and there is also an overall saving up to 40% in fuel, transportation, handling, etc., in plants where the Holofol process is used, the author of the article, W. Opavsky, claims.

This process, moreover, seems to be particularly suitable for articles in which the sheet is 0.5 to 3.0 millimeters thick, and it can be used for all the customary rubber compounds, whether made with 20 or 90% rubber. The good aging properties of the goods made by the method are particularly stressed.

Special apparatus has been developed for the process. A Holofol installation of normal size, it is said, is serviced by two persons, and its conveyor capacity is 60 to 80 square meters per hour for material having an original thickness of one millimeter. The number of articles that can be produced in a given time is calculated from the number of pieces which can be placed on one square meter of conveyor belting.

[1] See our Mar., 1952, issue, p. 770
[2] Sept., 1953, p. 86.

Editorials

Let's Take Another Look at the Future of Basic Rubber Research

READERS of India RUBBER WORLD are acquainted with the series of editorials on the subject of the future of synthetic rubber research that appeared on this page July through December, 1953, and the article in our December, 1953, issue, entitled "A Plan for Synthetic Rubber Research and Development." The article was a summary of opinions and ideas on this subject provided by interested persons in the National Science Foundation, the National Bureau of Standards, the Reconstruction Finance Foundation, and elsewhere. The editorials consisted of opinions and ideas obtained from research directors in the rubber industry.

Further comments on the subject are contained in the lead article in this issue, "Industry Sponsored Rubber Research Program," by H. J. Osterhof, Goodyear Tire & Rubber Co., which was given before a joint Army, Navy, Air Force Conference on Elastomer Research and Development in Washington, D. C., in January.

Dr. Osterhof emphasizes that industry is fully prepared to take on all phases of synthetic rubber research, including ample financial support for fundamental research. Industry, however, will finance only those types of applied research where the potential volume of the end-product will provide a return to cover costs. It is suggested that a questionnaire be circulated to determine if operation of the Government Evaluation Laboratory in Akron, O., is desired by industry, and, if so, that the National Science Foundation supervise its operation.

It is interesting to note that in the December article it was suggested that funds for continued basic synthetic rubber research be obtained from the sale of the government-owned plants and that the Government Laboratory facilities be sold to the University of Akron for continued use by both the military services and private industry. Industry, as far as the Osterhof talk is concerned, has apparently accepted the principle of the use of some of the money obtained from the sale of the plants for continued operation of the Government Laboratory facilities on applied research and development projects, but maintains the position that all the fundamental research necessary could and should be done by private industry.

In March the board of directors of the University of Akron, which includes representation from the rubber industry in Akron, proposed to the Rubber Facilities Disposal Commission that the Government Laboratories be sold to the University for a nominal sum, and that $5 million from the sale of the synthetic plants be appropriated to the University for the operation of the Laboratory facilities for a period of three years. Research and development work for the military services, and for private industry on a fee basis, could thus be continued. Beyond the three-year period, operation of the Laboratory in a similar manner, or with an additional appropriation from Congress, or its return to the government, were suggested as possible choices.

Justification for the above proposal was based on the indicated expansion of synthetic rubber research by industry; obviating the necessity of duplication of costly pilot-plant equipment, at least at present; and the disadvantages of breaking up the highly trained and experienced research and development staff while the synthetic rubber industry was in its relative infancy.

Two other situations which have come to our attention recently seem pertinent to this problem of the future of research on synthetic as well as natural rubber. The Reconstruction Finance Corp. in announcing its approval of a more than $4-million budget for synthetic rubber research for the fiscal year ending June 30, 1955, revealed that studies of the biosynthesis of natural rubber with radioactive tracers were being made. Meanwhile the rubber industry has taken a strong position for the continuation of the government's natural rubber research program in Latin America, which is threatened with abandonment because of a technicality regarding the use of funds.

Industry spokesmen, when asked to comment on the seeming contradiction of supporting the continuation of a government program of natural rubber research in Latin America and opposing the continued government or cooperative research on synthetic rubber in this country, explain that the results of the natural rubber research benefit all companies equally, while synthetic rubber research benefits each company individually.

Fundamental research in any field, by definition, is not designed to provide information for commercial development. It is by coincidence rather than design that the results of such research may be developed into commercial processes or products. Very few companies, since they are profit making organizations, can therefore devote the large sums of money necessary over the long term to keep such research active on the scale necessary to obtain the same knowledge for which their competitors are spending an equal amount of money.

Having spent the money, how long will it take the companies to decide whether there is any commercial value in the research, or that they may be published for other research workers to study?

What we are trying to point out is that the majority industry opinion that government or cooperative fundamental research is no longer necessary, once the synthetic rubber producing plants are in private hands, may be an over-simplification. On a cooperative basis the cost would be less, and the general availability of the knowledge greater.

R. G. Seaman

The Mechanical Properties of Polyethylene[1]

Robert H. Carey[2]

TEST methods for tensile strength, Young's modulus (initial tangent modulus), stress at elastic limit and at yield point, for determining stress-corrosion-cracking phenomena, and creep and stress rupture properties of polyethylene, are described and results given.

Tensile strength and final elongation are considered to be of limited significance. Short-time static tests indicate that yield point is a primary criterion for failure.

Long-time strength tests, the "elastic limit" in short-time tests, and data from stress-corrosion rupture tests qualitatively indicate maximum engineering design stresses of 1/3 or 1/4 of yield point.

At present these criteria apply only to room temperature, and there is no sure way of predicting the 20- or 30-year life.

The engineer must combine these data with his own judgment to assess the risks he must take.

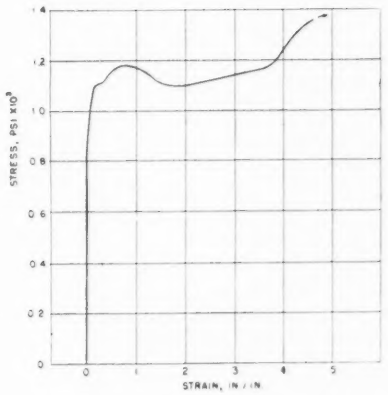

Fig. 1. Typical Low Magnification Stress-Strain Curve for a Bakelite Polyethylene Compound

THE applications of polyethylene have continued to expand since its introduction in commercial quantities more than 10 years ago. Originally the material was considered to be most useful because of its low electrical losses. It has been found, however, that its mechanical properties make it an ideal material for a wide variety of uses. Like most new materials, many of these uses were developed with a minimum of scientific or engineering background. When some of these early applications resulted in failures, it was realized that a better understanding of the mechanical nature of polyethylene would be necessary to insure its proper use as an engineering material.

Many early investigators considered polyethylene to be rubber-like because of its low stiffness or low apparent modulus of elasticity. Tensile tests performed at high straining rates on standard rubber testing equipment apparently confirmed this belief when breaking elongations of 400-500% were reported. The similarity of polyethylene and rubber was increased still further when carbon black was dispersed in the plastic to improve its weathering resistance.

Later it was realized that polyethylene's tensile properties more nearly resembled those of certain soft nonferrous metals (1);[3] i.e., it has a non-linear stress-strain curve and great ductility. The analogy may be carried even further since polyethylene has some degree of crystallinity (2-4) and, in common with metals, is susceptible to the phenomenon of stress-cracking or stress-corrosion (5). Like those of many plastics, glass, and metals such as lead, the mechanical properties of polyethylene are greatly dependent on the speed of application of the load, and the testing temperature.

Static Tensile Properties

The tensile properties of compression molded polyethylene are usually described by means of a stress-strain curve, as shown in Figure 1 (6). This curve may be divided roughly into three regions, as follows:

(1) From 0-50% strain (0-0.5-inch/inch) a "pseudo-elastic" behavior is observed. A rapid increase in load with comparatively little strain is followed by a general yielding producing a sharp "knee" similar to that observed with many metals.

(2) From 50-350% strain (0.5-3.5 inches/inch) the

[1]Presented at the National Technical Conference, Society of Plastics Engineers, Inc., Toronto, Ont., Canada, Jan. 29, 1954.
[2]Bakelite Co., Division of Union Carbide Carbon Corp., Bound Brook, N. J.
[3]Numbers in parentheses refer to bibliography at end of article.

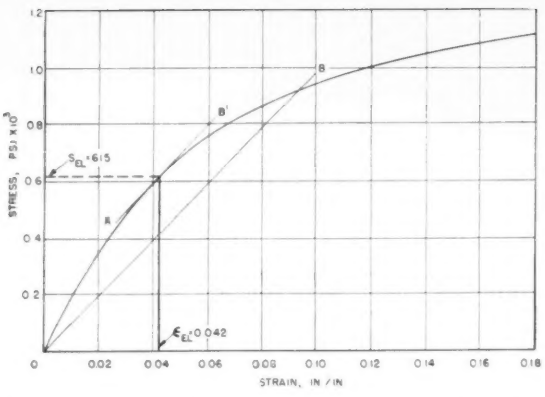

Fig. 2. Stress-Strain Curve for D-55 Polyethylene at 25° C.

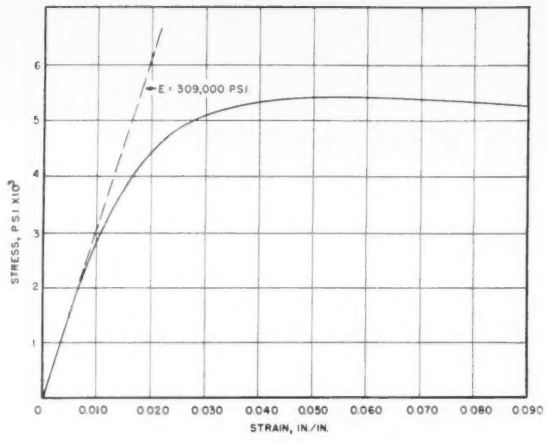

Fig. 3. Stress-Strain Curve for D-55 Polyethylene at —57° C.

material flows and deforms "plastically." The initial yield point is often followed by a drop in load and a lower yield point. Reductions in area become apparent, and "necking" occurs.

(3) From 350% strain to failure, increasing loads are observed. This region of the curve is greatly affected by the geometry of the specimen and the testing technique. At these extreme elongations, stress-strain curves of polyethylene (or of any other yielding material) are of questionable validity because "necking" renders meaningless any strain measured between gage marks.

Although curves such as Figure 1 are very useful, the "elastic" region between 0-20% strain, which is of prime importance in practical applications, is so condensed that no accurate information can be obtained. By using higher strain magnification and slower testing speeds, stress-strain curves of the type shown in Figures 2 and 3 have been obtained for injection molded polyethylene. By means of such curves the properties of several grades of polyethylene have been studied over a temperature range from —60 to +80° C.

The effects of temperature are qualitatively indicated by comparing Figures 2 and 3. Near room temperature (Figure 2) the curve is exponential and shows no well-defined yield point. At lower temperatures (Figure 3), in addition to an increase in the stress at any given strain, there is a change in the shape of the curve. Instead of being exponential, the initial portion of the stress-strain curve is quite linear and extends to high stresses. The "knee" of the curve is sharper, and a well-defined yield point is observable at about 7% strain.

As shown by Figure 3, the stress-strain curve for polyethylene at low temperatures is characterized by an initial straight-line portion. At these temperatures, therefore, the elastic modulus in tension is calculable by the accepted technique of drawing in the initial slope. This procedure is illustrated by the dotted line in Figure 3. Young's modulus calculated in this manner will be referred to as the initial tangent modulus. This technique of evaluation is satisfactory for the temperature range from —60 to about —30° C.

At temperatures above —30° C. a straight-line portion is no longer observable. It is evident that an extrapolation technique is necessary to obtain an initial modulus value comparable to the tangent modulus used at low temperatures. The nature of the stress-strain curve suggests an exponential behavior. By numerically differentiating the stress-strain curve and plotting the logarithm of the slope against the strain, a linear relation is obtained. This is illustrated in Figure 4 for the stress-strain data represented by the curve of Figure 2, and the method of evaluation may be used for data in the temperature range of —30 to +80° C.

Stress-strain curves of the types shown in Figures 1 and 2 are necessary to understand and interpret the mechanical behavior of polyethylene. In Figure 1, for example, the important point to be observed is the initial yield point which occurs at about 1,100 psi. At this stress a potential mechanical instability will be present. This implies that the engineer will be concerned only with stresses less than 1,100 psi., so that curves of the type shown in Figure 2 are needed.

With curves of the type of Figure 2, engineers for many years have used methods for empirically selecting some arbitrary "apparent elastic limit" or "apparent proportional limit." Of these methods, Johnson's (7) is most suitable since it gives results that agree well with field experience. In this method the apparent elastic limit is defined as the stress at that point on the stress-strain curve where the slope is 50% of the slope at the origin. In other words, this is the point where deformation with respect to stress is increasing 50% faster than at the origin. The elastic limit determined by this method is, of course, a very arbitrarily defined point, but a point indicative of the beginning of general plastic yielding of the specimen.

The numerical differentiation technique illustrated by Figure 4 has proved quite satisfactory in routine testing at room temperatures. There is little trouble in computing and plotting the points, and the extrapolation to zero strain eliminates the uncertainties present when graphical tangents to curves of the type of Figure 2 are being constructed. Once the initial modulus is determined, the 50% modulus is computed easily, and the strain at this value is read directly from Figure 4. The stress at the elastic limit may then be determined easily from the stress-strain curve of the type of Figure 2. At low temperatures where the straight-line portion of the stress-strain curve is well defined, graphical construction is most convenient (as illustrated in Figure 3).

Torsion Tests

It is impractical to make tests below —60° C. with conventional testing equipment. The temperature range from —60 to —125° C. can be covered, however, by using the Clash-Berg (8) or Bakelite torsion tester. To use this instrument over this temperature range and obtain data comparable with tensile results, the standard testing technique must be modified so that torque-angular twist curves are obtained. The slope of these curves,

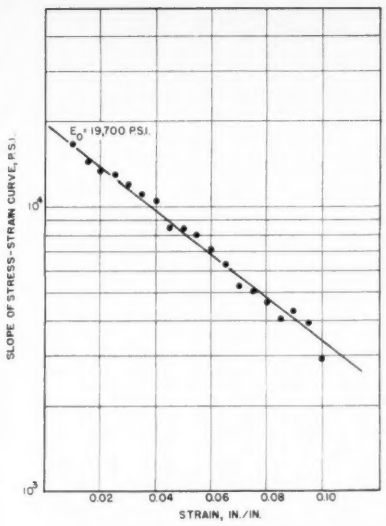

Fig. 4. Tangent Modulus *versus* Strain for D-55 Polyethylene at 25° C.

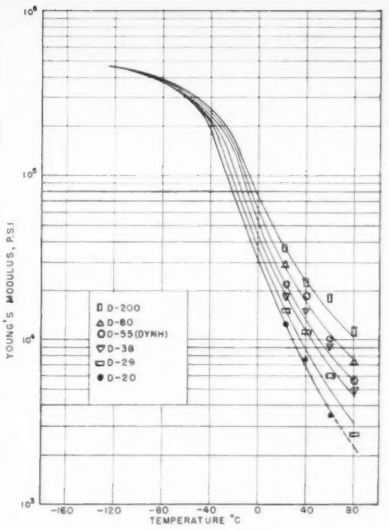

Fig. 5. Modulus *versus* Temperature for Several Grades of Polyethylene

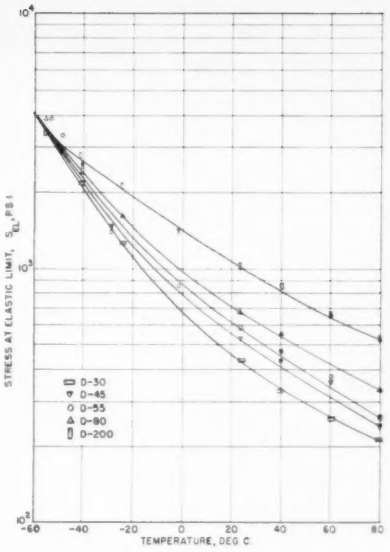

Fig. 6. Effect of Temperature on Stress at Elastic Limit for Several Grades of Polyethylene

easily obtained by graphical construction, is equivalent to the shear modulus of elasticity. Young's modulus (E) is computed from the shear or rigidity modulus (G) by the following equation (assuming Poisson's ratio to be 0.5): $E = 3G$.

Effects of Temperature and Molecular Weight on Stress-Strain Properties

Polyethylene resins of different molecular weights have been investigated over a wide temperature range by the tensile and torsional techniques previously described. The resins used in this work are designated by the "flow height" in mils (0.001-inch) preceded by the letter "D," as described by Maibauer and Myers (9). The flow heights were determined by the Williams plastometer method. Table 1 lists various resins and their weight average molecular weights as determined by the solution viscosity method of Kemp and Peters (10).

TABLE 1. MOLECULAR WEIGHTS OF VARIOUS POLYETHYLENE RESINS

Polyethylene Resins		
Flow Height Grade	Bakelite Designation	Average Molecular Weight
D-30	.....	16,000
D-45	.....	19,000
D-55	DYNH	20,000
D-65	DYNJ	22,500
D-75	DYNK	25,000
D-80	.....	26,000
D-100	.....	29,000
D-200	.....	38,000

Modulus

As previously noted, the initial tangent modulus can be evaluated by several techniques, depending on the temperature range involved. From +80 to −30° C. the exponential extrapolation method should be used; in the −30° C. range the initial tangent to the stress-strain curve is evaluated graphically; and in the −25 to −125° C. range the initial torsional modulus is determined. All these data are plotted in Figure 5 as modulus *versus* temperature curves for the different resins.

All the data obtained by the different techniques fall along smooth curves. The agreement between torsional data and the values derived from tensile curves is very satisfactory over the common temperature range. On the semi-log scale of Figure 5 the curves show the inverted-S shape typical of many plastic materials. The properties of the different molecular weight resins are described by a family of curves quite widely separated at 80° C., but merging into a single line below about −50° C. At this low temperature, differences between the curves, if any, cannot be detected by the testing techniques described here. No attempts were made to test at temperatures higher than 80° C. because polyethylene has a relatively sharp melting point at 100-110° C., depending on molecular weight.

Stress at Elastic Limit

Figure 6 shows the variation of stress at the elastic limit as a function of temperature for five different molecular weight resins. These curves are similar in shape and form to the modulus-temperature curves of Figure 5, being widely separated at room temperature and converging to a single value at −50° C. It is of interest to note that all five resins retain a high degree of strength even at 80° C., a temperature only 20-30° C. below their melting points.

In many engineering problems the actual load or stress conditions are unknown, but the shape of the deformed article (and hence its strain) is easily measured. For good design this "deformed" strain should be below the strain at the elastic limit. A plot of strain at the elastic limit as a function of temperature is shown in Figure 7. Within experimental error, this strain is independent of resin molecular weight.

Stress at Yield Point

Figure 8 is a plot of stress at yield point as a function of temperature for two commercial grades of polyethylene. These data were obtained on compression molded samples at a testing speed of one inch per minute, using commonly accepted procedures. The yield points shown are considerably higher than the elastic limit stresses and represent the maximum loads obtainable before "necking" or drawing of the specimens occurs.

Stress-Corrosion Cracking

Under no-load conditions, polyethylene is resistant to a wide variety of chemical reagents and shows no change in weight when immersed in such reagents. The coincident action of these same reagents and stress, however,

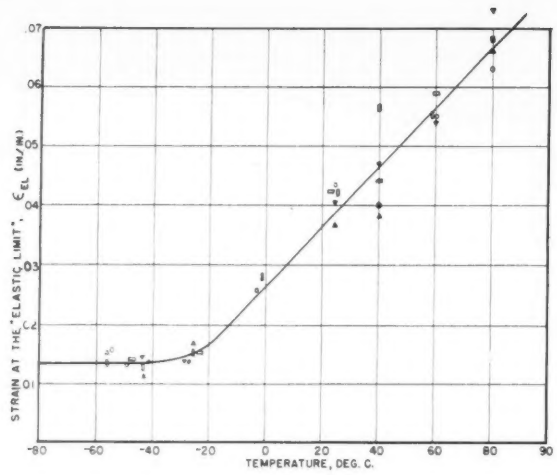

Fig. 7. Effect of Temperature on Strain at Elastic Limit for Several Grades of Polyethylene

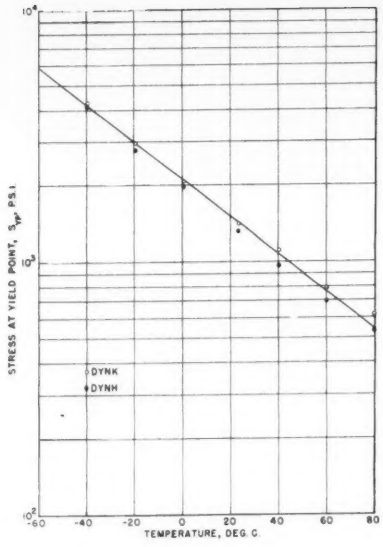

Fig. 8. Effect of Temperature on Stress at Yield Point for Two Grades of Polyethylene

may produce the phenomenon known as stress-corrosion cracking. In certain environments and stress conditions polyethylene suffers a reduction in elongation that is particularly disturbing when judged from the "rubber-like" viewpoint.

The stress-cracking phenomena (11) were first observed in tests where strip specimens were bent through 180 degrees, scored with a razor, and immersed in chemical agents. This procedure is now a standard stress cracking test. After a period of time, depending on the resin, temperature, and reagent, specimen fracture (of a brittle nature) occurred on the scored side which was held under a tensile stress. This method of investigating stress-corrosion cracking was of limited value because the actual stress-strain condition was not known, and the effects of creep and relaxation entered to an unknown extent.

A more direct approach was to obtain stress-strain curves of the material while it was immersed in various fluids. Exploratory tests with tensile specimens that were die-cut from extruded stock showed a much lower breaking strain when they were tested in ethyl alcohol than when tested in air. The die-cut specimens, however, possessed many surface irregularities because of the cutting action of the die. Injection molded specimens were then made, and it was found that with no surface imperfections brittleness was not apparent even in the lower molecular weight resins. If the edge of the specimen was nicked or scored, however, fracture occurred in a brittle manner.

Several tests with the nicking technique failed to show sufficient reproducibility to distinguish between resins of different weights. Since this technique is difficult to control, it was abandoned, and the "stress-raiser" effect produced by drilling a 1/16-inch diameter hole through the center of the specimen. With a specimen 1/2-inch wide and 1/8-inch thick, the ratio of hole diameter to specimen width is 0.125:1. This provides an arbitrary geometric condition that serves to distinguish between resins and is of the same order of magnitude as that used in tests of aluminum (12).

Complete stress-strain curves made with such specimens indicated that the presence of a hole and a chemical agent resulted primarily in a shortening of the curve. The shape of the initial portion of the curve was not altered appreciably. These effects were examined with a variety of liquids for five injection molded samples of resins varying in flow height from 0.045-0.100-inch.

Samples without a hole broke at elongations of 70-140%. This is the elongation expected of injection molded samples and is well below the 400-600% commonly reported for extruded or compression molded samples of equivalent molecular weight. In general, the elongation observed when no hole was present was not affected by the resin molecular weights or by the surrounding liquid. The presence of a hole, however, caused a distinct reduction in elongation.

As shown in Table 2, the elongation in air, distilled water, or soapy water was 40-50%, regardless of resin molecular weight. In toluene and the alcohols, however, the elongations, although less than in air, were dependent on molecular weight. This point is particularly true with n-amyl and t-amyl alcohols where regularly increasing elongation occurs with increasing molecular weight.

TABLE 2. BREAKING ELONGATIONS, %, OF INJECTION MOLDED POLYETHYLENE SPECIMENS WITH 1/16-INCH DIAMETER HOLES

	Environment						
Resin Grade	Air	Distilled Water	Soapy Water	Ethyl Alcohol	n-Amyl Alcohol	t-Amyl Alcohol	Toluene
D-45	51	60	51	18	6	7	14
D-55	62	54	41	38	15	13	18
	39	42	46	36	20	20	14
D-65	45	45	51	44	25	20	21
D-85	42	44	44	40	29	26	20
D-100	48	47	47	44	36	38	38

Table 3 compares the specimens (with a hole) on the basis of breaking stress. This stress is dependent on the resin molecular weight, whether tested in air or alcohol. The lowest molecular weight resins are more greatly embrittled by alcohol and toluene than the highest weight resins. Stress at fracture follows a more regular pattern with molecular weight than does strain at fracture (breaking elongation).

TABLE 3. TENSILE BREAKING STRESS, IN PSI., OF INJECTION MOLDED POLYETHYLENE SPECIMENS WITH 1/16-INCH DIAMETER HOLES

(Stresses are Nominal Values from Net Cross-Sectional Area at Hole)

	Environment						
Resin Grade	Air	Distilled Water	Soapy Water	Ethyl Alcohol	n-Amyl Alcohol	t-Amyl Alcohol	Toluene
D-45	1,220	1,360	1,260	1,010	790	810	970
D-55	1,620	1,680	1,660	1,560	1,240	1,250	1,310
	1,780	1,830	1,740	1,660	1,420	1,400	1,330
D-65	1,750	1,890	1,900	1,810	1,550	1,520	1,460
D-85	1,930	2,120	2,080	2,020	1,900	1,860	1,670
D-100	2,160	2,250	2,240	2,210	2,080	2,100	1,900

The explanation for the behavior shown in these tables can be found in texts on engineering materials (13).

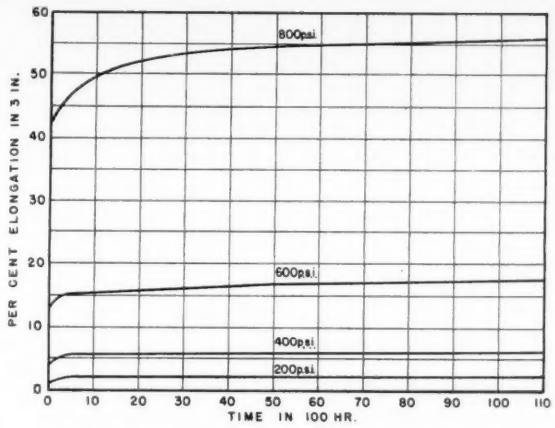

Fig. 9. Creep of Polyethylene at Various Stresses

Ductile materials which fail primarily by "sliding" or "slipping" can be made to fail like brittle materials, depending on the speed of deformation, test temperature, and specimen geometry.

"Plastic" deformation in crystals is usually accompanied by sliding along certain crystallographic planes. Sliding or yielding begins when the magnitude of the shearing stress reaches a limiting value. In so-called brittle materials, stretching due to sliding is small, and fracture occurs by overcoming cohesion. A ductile material can show a brittle type of fracture if the form of the test specimen or the type of stress distribution is such that deformations due to sliding are prevented.

For this reason it is necessary that the stress-strain curve for polyethylene be completely understood. The alcohols and solvents used in these tests show their effect principally in a shortening of the stress-strain curve. Yielding or sliding of the crystals is prevented somehow by the solvents, and the material fractures in a brittle manner.

Undoubtedly time is an important factor in embrittlement. No attempt was made in these experiments to control this time factor other than to perform all tests at the same rate of straining (0.1-inch per minute) and to avoid unduly long immersions. The actual immersion times were from 2-10 minutes.

Creep and Stress Rupture

The creep and stress rupture properties of polyethylene and its compounds are of primary interest to all engineers. Gohn, Cummings, and Ellis (14) have obtained creep data at 85° F. on compression molded sheet stocks made both with and without antioxidants and carbon black. The creep characteristics of these materials are much the same, and, for all practical purposes, the data may be considered representative of the creep of commercial grades of polyethylene such as DYNH.

Typical creep curves at 85° F. are given in Figure 9 for tensile stresses of 200, 400, 600, and 800 psi. These curves show an instantaneous elongation whose magnitude increases with increasing stress. At zero time this elongation is approximately equivalent to that obtained in a static tensile test. The instantaneous elongation is followed by a further increase in strain which continues at a decreasing rate, depending on the stress. At the higher stresses (600 and 800 psi.) it requires about 2,000 hours to complete the initial extension or first stage of creep; whereas this extension is completed in a relatively short time at the lower stresses. In the second stage of

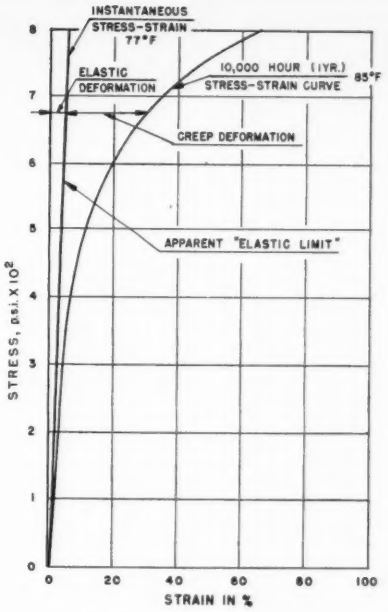

Fig. 10. Short-Term and Long-Term Stress-Strain Curves for Polyethylene

creep there is a slow extension during which the creep rate decreases gradually and approaches a constant rate (straight line).

The creep curves of Figure 9 are interpreted by plotting the creep rate or slope of the straight-line portion as a function of applied stress. In most engineering design work it is also important to know the total extension occurring after a given period of time. Gohn, Cummings, and Ellis (14) have plotted total extension as a function of stress after 10,000 hours' elapsed time. They have shown the total extension in 10,000 hours to be as great as 60% at 800 psi., but only 4% at 300 psi.

The short- and long-term properties of polyethylene may be compared conveniently by constructing a pseudo stress-strain curve from the creep data, as shown in Figure 10. The imperfect elastic nature of polyethylene is demonstrated by such plotting. Unfortunately, there is again no definite demarcation between elastic and inelastic behavior, and the engineer will have to interpret the data to suit his particular application.

The total elongation (creep) at 200 and 400 psi. is approximately equal to the value obtained in static tensile tests. At 800 psi. the total elongation is much greater than that obtained in a static test. At 600 psi. a borderline condition exists which the engineer must evaluate for his particular application. It should be observed that all the stresses shown in Figure 10 are less than the yield point, and no fractures occurred even when the samples were held under these stresses for 10,000 hours (1.1 years).

Creep data, although of interest in many problems, do not necessarily provide any information about fracture or failure. Stress-rupture and stress-corrosion-rupture tests by Ellis and Cummings (15) performed on compression molded tensile specimens, and hydrostatically inflated pipe samples give this type of information.

Tensile stress-corrosion-rupture tests were made on specimens having a polyaxial stress condition introduced by four transverse slits (0.010-inch deep) cut across the width of the tensile specimen. The edges and surfaces of the specimens were then treated with Igepal CA Extra,[4]

[4]General Dyestuff Corp., New York, N. Y.

a surface-active agent known to be deleterious and to provide a powerful cracking environment.

Specimens not coated with the cracking agent did not fail at 10,000 hours when stressed at 200, 400, or 600 psi. Coated specimens failed in less than one-half hour (with elongations of 6.5-16%) when stressed at 500-800 psi. At 400 psi., failures of the coated specimens took place at 3% strain. A curve plotted from these data reaches an asymptote at about 250 psi. stress, indicating that there will be no fractures below this stress for an indefinitely long time.

The stress-corrosion-rupture tests on pipe were made with tubes of polyethylene having a $2\frac{3}{4}$-inch outside diameter and $\frac{1}{8}$-inch wall. Three grades of polyethylene were tested, having flow height ranges of 52-56, 62-68, and 75-81. The specimens were coated with Igepal CA Extra and inflated with air. The surface of the tube was under biaxial stress. The air pressure was adjusted to give circumferential (or hoop) stresses from 400-1,400 psi. Because of the specimen shape, the longitudinal stress was one-half the circumferential stress.

The D52-56 polyethylene samples showed no failures after 10,000 hours at stresses under 430 psi. D62-68 samples showed an asymptotic stress of 610 psi.; while D75-81 resins reached an asymptote at approximately 1,120 psi. stress. Pipe samples which were not coated did not fracture even though they were held at stresses corresponding to those used for the coated specimens. Pipe specimens from D52-56 resins, however, showed brittle failures even though uncoated when they were held at stresses above those reported for the coated specimens. Such failures are to be expected under biaxial stresses, as shown by Hopkins, Baker, and Howard (16).

Summary and Conclusions

Several test methods for describing the mechanical properties of polyethylene have been discussed. The selection of the test method to be used depends primarily on the application under consideration. It is quite evident that no method is sufficient to describe this material. For this reason it is wise to avoid conclusions which may be too general. Most of the methods are designed to point out the limitations of a material. This philosophy is common with most engineers and laboratory technicians who are concerned primarily with the failures that occur and seldom have time to review the successes.

All of the data show that the tensile strength and final elongation are of limited significance. Short-time static tests show that the yield point is the primary criterion for failure under polyaxial stress conditions. Long-term strength tests (the elastic limit in short-term tests) and data from stress-corrosion-rupture tests qualitatively indicate maximum engineering design stresses of one-third or one-quarter the yield point. At present these criteria apply only to room temperatures and adjustments must be made to meet service temperature conditions. There is, at present, no long-term stress information dealing with elevated temperatures, and use of the criteria given in this paper is bound to be hazardous for such high temperatures.

It should be further noted that these criteria provide no factor of safety as used in the customary sense. They do provide a safety factor, however, against the possibility of accidental polyaxial stresses, or accidental contact with damaging chemicals. As with all things, the engineer must combine these data with his own judgment in order to assess the risks he must take. There is no sure way of predicting material behavior over 20 or 30 years of life. Time alone will tell whether these criteria can be extended to service lives of such magnitude.

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Meetings and Reports

SPE Conference Chairmen Named

OFFICERS and chairmen of the arrangements committee for the eleventh annual National Technical Conference of the Society of Plastics Engineers, Inc., have been named by the Society's Philadelphia Section, which is sponsoring this meeting. The Conference will be held in Atlantic City, N. J., at the Chalfonte-Haddon Hall Hotel in January, 1955.

Conference officers are as follows: chairman, Adolph J. Kissileff, Amplex Mfg. Co.; co-chairman, George H. Koch, Jr., Oak Engineering Co.; honorary chairman, Richard B. Bishop, Foster Grant Co.; secretary, Edward J. Fitzpatrick, F. J. Stokes Machine Co.; and treasurer, Henry S. Darlington, Jr., A. H. Wirz Co. Named as subcommittee chairmen were the following: liaison and publicity, C. C. Davies, Stokes-Trenton, Inc.; house, Edward L. Derowski, Penn Plastics Corp.; program, William O. Bracken, Hercules Powder Co.; and registration, Don I. Yarnall, Rohm & Haas Co., Inc.

Sections' Meeting Reports

Panel on High-Speed Molding

A record attendance of more than 300 members and guests featured the April 14 dinner-meeting of the Newark Section, SPE, held at the Military Park Hotel, Newark, N. J., which was highlighted by a panel discussion on "High-Speed Automatic Injection Molding." The panel members were W. Fleming Standard Tool Co.; Fred C. Means, Fellows Gear Shaper Co.; Ernest P. Moslo, Moslo Machinery Co.; W. E. Smith, Guy P. Harvey & Son Corp.; and George W. Whitehead, Improved Machinery, Inc. Islyn Thomas, Newark Die Co., acted as panel moderator.

The panel members outlined the economies obtainable through the use of automatic machines, including faster molding cycles, lower labor costs, lower mold costs, lower machine maintenance costs, fewer rejects, and reduced scrap. Articles weighing up to two ounces should be molded automatically, it was said, even though

many parts in this weight range are currently being made in multi-cavity molds on larger machines. It was emphasized that today's automatic machines feature improved safety devices so that severe damage cannot occur because of flashing or sticking parts.

The panel stressed the need of good mold design to take advantage of automatic molding. It was pointed out that knock-out pins must be alined perfectly, and that due consideration must be given to the proper molding conditions for each particular plastic material.

In reply to questions from the floor, the panel members stated that weigh feeders provide no definite advantage at present in automatic molding, but that such feeders will be developed in the future for this application. Preplasticizing units are also unnecessary on small automatic machines because their own plasticizing capacities are adequate.

Table favors were distributed through the courtesy of Plastic Molders Supply Co., and there was a drawing for door prizes donated by Gering Products, Inc.; Sterling Plastics Co.; and Industrial Synthetics Corp.

Silicone Plastics

The April 21 dinner-meeting of the New York Section, SPE, featured a talk on "Silicones in the Plastics Industry" by Bruce Thorsberg, Dow Corning Corp. Held at the Gotham Hotel, New York, N. Y., the meeting attracted some 70 members and guests and included a cocktail hour, dinner, and business session.

In reviewing the history of silicone plastic materials, Mr. Thorsberg said that acceptance has been slow because of high material and handling costs, long cure cycles, and the fact that there is no silicone resin, as yet, that can be used for unsupported film, clear castings, or solid structural high-temperature parts without reinforcement by fibers or fabrics.

Silicones in the plastics industry are available in three major forms: laminating and bonding resins, molding compounds, and rigid resin foams. The laminating resins are available in low-pressure (30 psi.) and high-pressure (1,000 psi.) types and are used for structural parts requiring high dielectric strengths, and high strengths at elevated temperatures. These laminates are generally made with glass or asbestos cloth.

The silicone molding compounds previously available required molding cycles of 20-30 minutes, the speaker noted. Dow Corning recently developed a new compound that requires five minutes for molding, after which the parts can be removed, while hot, and do not require an afterbake. Suggested applications include electrical switch parts and high-temperature mechanical parts.

Silicone rigid resin foams are comparatively new materials highly resistant to thermal shock and high temperatures (700° F.), and can be foamed in place. The properties of the foams suggest their use in fire wall structures, insulation, and heat-stable buoyant structures, Mr. Thorsberg declared.

In addition to silicone fluids and emulsions used as mold release agents in the plastics industry, other new developments in silicones are under way. These developments include pressure-sensitive adhesives which retain their tackiness at high and low temperatures; silicone fluids for coating certain plastics to improve their surface resistivity; and resins with improved compatability that can be used as additives for polyester and epoxy resins to increase moisture and heat resistance.

In the business session preceding the talk, Harold H. Schwartz, of Empire Brushes, Inc., and Section president, announced the appointment of A. L. GeWertz, manufacturers' representative, to the board of directors for one year, replacing R. M. Thews, Monsanto Chemical Co., who has been transferred to Springfield. Alan K. Zimmerman, Monsanto, was appointed chairman of the program committee, effective with the May meeting.

Table favors were distributed through the courtesy of Premier Plastics Co., and the meeting closed with a drawing for door prizes contributed by Leaf Plastics, Inc., and H. Muehlstein & Co., Inc.

Rigid Vinyl Discussed

Two speakers from Firestone Plastics Co. on the subject of "Polyvinyl Chloride, A New Material of Construction" featured the March 23 regular dinner-meeting of the Philadelphia Section, at the Franklin Institute, Philadelphia, Pa. The speakers were B. K. Lyckberg, who discussed the history of the unplasticized vinyl chloride, and J. R. Bukey, who spoke on current domestic applications of these materials.

While the development of rigid vinyls in this country has been rather slow, Mr. Lyckberg noted that more than 10% of PVC production in Western Germany today goes into rigid applications. In 1944 alone, the Germans used 60,000,000 pounds of rigid vinyl pipe to replace stainless steel for chemical applications. Successful applications were made in pipe and tanks handling hydrochloric, sulfuric, and fuming nitric acids.

Mr. Bukey stated that the development of rigid vinyl has given the engineer a new material of construction that combines sufficient workability, structural strength, impact resistance, and hardness to replace metals in many forms. In addition, the plastic offers such inherent properties as extreme corrosion resistance, dimensional stability, low maintenance, ease of fabrication, light weight, good aging, excellent electrical resistivity, and good heat insulating properties.

Rigid vinyls are processed by conventional thermoplastic techniques, including calendering, extrusion, and compression, transfer, and injecting molding, Mr. Bukey noted. In the manufacture of plate stock, sheets ranging from 0.010-0.030-inch in thickness are made on a plastic calender and subsequently laminated under heat and pressure to form thicker plates. Pipe is extruded in diameters up to six inches, and in larger sizes by special techniques. Bar stock in various profiles and shapes is extruded in sizes up to four inches in diameter. Pipe fittings and special shapes are made by molding. Standard fittings are available in sizes from ¼-6 inches.

Talk on Vacuum Forming

Speaker of the evening at the April 21 dinner-meeting of the South Texas Section, SPE, held at the Santa Anita Restaurant, Houston, was J. W. Mighton, Dow Chemical Co., who discussed "Vacuum Forming of High-Impact Polystyrene Sheet."

Mr. Mighton noted that high-impact polystyrene sheet, with its good balance of properties and relatively low cost, has been an important stimulus to the growth of vacuum forming. In addition to ease of forming by means of vacuum and drape forming techniques, the sheet can also be formed with matched metal dies. The speaker also discussed trimming and preprinting operations for formed sheet, and the new continuous vacuum forming method for extrusions. Applications for formed parts were described and illustrated by means of samples, and the talk concluded with a demonstration of vacuum forming.

Discuss Plastics in Hobbies

The February 18 dinner-meeting of the Eastern New England Section, SPE, had as its theme, "Plastics as a Hobby." Fifty-four members and guests attended the meeting which was held in the Hotel Beaconsfield, Brookline, Mass., and featured two speakers: Ralph L. Mondano, Raytheon Mfg. Corp., on "Plastic Embedments as a Hobby"; and Ernest E. Morenon, Fenway Studios, on "Plastics in the Arts."

Mr. Mondano discussed and showed samples of his work in making acrylic and polyester embedments of flowers, leaves, shell fish, and other objects. Mr. Morenon is a sculptor, and he described his work with vinyl plastigels for model making. Samples of vinyl models were displayed, as well as sculptings made from acrylic plastics.

New officers, directors, and committee chairmen of the Group for 1954 were introduced during the business session preceding the talks. The new officers are: president, William L. Root, Jr., Raytheon; vice president, Richard W. Beckwith, Dow Chemical Co.; secretary, Walter W. Peacock, Jr., Naugatuck Chemical Division of United States Rubber Co.; treasurer, Harry E. Connors, B. F. Goodrich Chemical Co.; and national director, John W. LaBelle, Foster Grant Co. Other directors, in addition to the officers, are: J. D. Crosby, Hood Rubber Co.; R. C. Davenport, Gregstrom Corp.; M. S. Haas and F. P. Quartarone, both of Bolta Co.; F. H. Langhorst, Stanley Chemical Co.; and Mr. Mondano.

The new committee chairmen follow: program, Mr. Root; membership, D. W. Towler, M. W. Kellogg Co.; credentials, Mr. Quartarone; publicity, A. I. Simon, Raytheon; educational and professional activities, Mr. Mondano; house, Mr. Connors; and SPE reporter, Mr. Peacock.

Tour Inland Plant

The April 1 meeting of the Miami Valley Section, SPE, took the form of a tour through the plastics molding department of Inland Mfg. Division, General Motors Corp., Dayton, O., followed by a dinner in the company's cafeteria. J. H. Overwein and other Inland plastics engineers who are members of the Section acted as conductors for the tour, in which 71 members and guests participated, and which featured a step-by-step demonstration of the molding and finishing operations in making butyrate steering wheels.

A short business meeting was held after dinner, at which reports and announcements of future meetings were presented.

Beech-Nut in Vinyl Field

BEECH-NUT PACKING CO. has formed a chemical department to manufacture polyvinyl acetate resins. According to J. S. Ellithorp, Jr., president, the new department will operate out of the company's headquarters in Canajoharie, N. Y., and manufacture vinyl acetate resins in both solid and emulsion forms for use in textiles, adhesives, and coatings.

Wyrough & Loser, Trenton, N. J., has been appointed sales agent for the department, covering New England, the Middle Atlantic States, Delaware, Maryland, Virginia, and the District of Columbia.

Plastics Predominant at Packaging Show

PLASTICS played a prominent part at the twenty-third National Packaging Exposition held at Convention Hall, Atlantic City, N. J., April 5-8, under the auspices of the American Management Association, 330 W. 42nd St., New York 36, N. Y., which attracted 25,000 visitors (a record), who viewed the packaging materials, equipment, and services of 360 exhibitors occupying some 130,000 square feet of floor space.

Vinyl film for packaging covered a wide range of goods, including food, clothing, tobacco products, chemicals, pencils, tools, war materiel, flowers, jewelry, toys, ball bearings, and even a Buick convertible. The film came flexible or rigid, in a wide variety of shapes and sizes, and colored, transparent, or opaque. Molded boxes, jars, and other containers vied for attention, as did screw tops, bottle stoppers, and similar items—many in eye-arresting colors, including mottled effects. Squeeze bottles also were conspicuous.

Celanese Corp. of America featured acetate transparent films and polyethylene for foods; acetate for barrier wraps and toys; rigid acetate containers for costume jewelry; and vacuum formed packages.

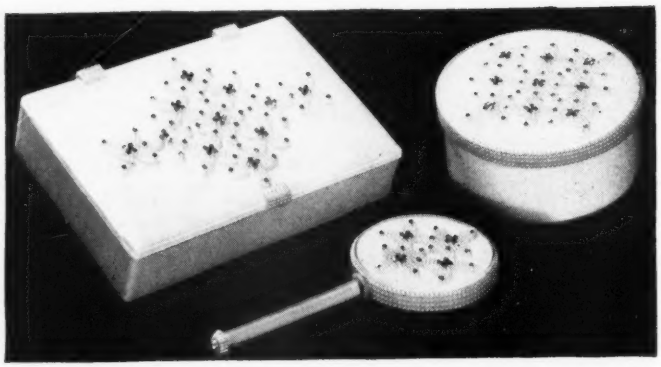
A demonstration of the loading of aerosol products and how aerosol containers work drew crowds to the exhibit of E. I. du Pont de Nemours & Co., Inc. Among the many company products on display were "Alathon" polyethylene resin materials for containers and protective coatings; also cellophane, polyethylene, and acetate films.

Eastman Chemical Products, Inc., in an attractive display showed butyrate film former for protective and decorative foil and paper lacquers.

An unusual item, seen at the Foam-Pak Co. booth, was the Foam-Pak Cellular Plastic Platforms—expanded polystyrene crystals, forming a light shock-resistant composition of cells, resulting in a snow-white spongy platform on which delicate merchandise may be encased before boxing.

Another interesting display was that of B. F. Goodrich Chemical Co. Included were Geon vinyls for packaging; flexible vinyl film for small units as electrolytes for dry charged storage batteries, motor oil, silicone greases, paste pigments, putties, and calking compounds; flexible vinyl film liners for cylinders, boxes, drums, and bags; Geon vinyl coatings; bottle protectors of paste resin formulations; molded boxes; and a worker demonstration of packaging meats and cheese in a special film made from Geon polyblend, and also packaging pencils in vinyl film.

Monsanto Chemical Co. exhibited more than 50 plastic packages utilizing Vuepak cellulose, Lustrex styrene, or polyethylene. Eye-catching were the jeweled boxes molded of Lustrex styrene. Monsanto also featured a complete line of its plasticizers in films, coatings, and adhesives. A special attraction was the coffee served in taste-free, leakproof plastic-coated "take-out" food containers (made by Sealright Co., Inc., using Monsanto plastic coatings and non-toxic plasticizers).



Pearls and Rhinestones Add Beauty to Boxes Molded of Lustrex Styrene by Tri-State Plastic Molding Co.

Among the very attractive exhibits was that of Owens Illinois Glass Co. Here the visitor found colored plastic tire valve caps in a glass vial sealed with a polyethylene closure; mottled urea closures and Plastainer plastic vials in a variety of color combinations and sizes for many products; and plain plastic closures and fitments.

On display by Reynolds Metals Co. was plastic film, cast and extruded for packaging, embracing polyvinyl alcohol, polyvinyl chloride, polyethylene, and polyethylene-polyvinyl alcohol laminates. Demonstrated was a polyvinyl alcohol-water soluble bag containing a detergent, for use in washing machines.

What drew the largest crowds was the 1954 Buick convertible encased in a seamless one-piece polyethylene tube—said to be the world's largest polyethylene bag—made of "Vis Queen," product of The Visking Corp.

Adhesives formed a goodly portion of many displays, including those of Arabol Mfg. Co., H. B. Fuller Co., Manhattan Paste & Glue Co., Inc., Mystik Adhesive Products, National Starch Products, Inc., Paisley Products, Inc., Seamless Rubber Co., Stein-Hall & Co., Inc., and Swift & Co.

Some of the squeeze bottles of Plax Corp. were made of polyethylene; while others utilized cellulose acetate butyrate.

Among the many boxes on view were those of Tri-State Molding Co., Inc.—crystal-clear, rigid plastic boxes.

Plastic film was featured by many exhibitors including Bakelite Co.; Dewey & Almy Chemical Co.; Dow Chemical Co.; Durethene Corp., which displayed Ionfilm, polyethylene processed for permanent printing; H. P. Smith Paper Co., which featured Polycel, polyethylene coated cellophane; and Cheslam Corp., which showed Cellothene, a flexible, transparent film laminate of polyethylene and cellophane.

Also prominent was an assortment of tapes by a host of manufacturers such as Hampton Mfg. Co., Industrial Tape Corp., Minnesota Mining & Mfg. Co., Owens-Corning Fiberglas Corp., Seamless Rubber (with a special tape designed for use on foam rubber); and York Tape Printers.

Transparent bags also were much in evidence including those of Bemis Bro. Bag Co. and Plastomatic Corp.

Among other products on display were parts of plastic for containers for aerosol products by many makers; Clearsite transparent plastic containers from Celluplastic Corp.; decalcomania, by Meyercord Co.; flexible plastic tubes and bottles, Bracon-Bradley Container Corp.; Flextite fasteners for polyethylene and vinyl containers, made by Flexigrip, Inc.; fibreglass containers for packaging delicate guided missiles, Sperry Gyroscope Co.; package decorations and self-adhesive bows, Parfait Promotional Packaging Co.; roll-type heat-sealing labels, Marathon Corp.; Magic Marker, a marking device for marking and labeling many materials including plastics and rubber, by Speedry Products, Inc.; pressure-sensitive tape dispensers—many in plastic cases—from Penn Tape Savers; coatings, by Federal Adhesives Corp.; Poly-Seal closures, plastic screw caps with polyethylene cone liner, Poly-Seal Corp.; and packaging adhesives and specialty products, including coatings and resins, The Borden Co.

Goodyear Tire & Rubber Co. devoted its booth to Pliofilm and a machine packaging fish in Pliofilm wrappers.

Rubber was most inconspicuous at the Packaging Show. It was seen, however, in the Crown Slip Rubber Ring for jar closures, made by Crown Cork & Seal Co. Chase Bag Co., although experimenting with rubber for liners for food bags, still prefers plastics.

Machinery naturally played a prominent part at the exposition. Among the many manufacturers were Cameron Machine Co., Exact Weight Scale Co., Hobbs Mfg.

A 1954 Buick Convertible Enveloped in a Seamless One-Piece Tube of "Vis Queen"

Co., General Electric Co., which exhibited photoelectric relays and electronic timers, and Gus B. Harvey & Sons, with its two-ounce automatic injection molding machine.

Packaging Conference

Coincident with the exposition was the A.M.A. Packaging Conference, also held at Convention Hall. Eleven hundred packaging executives, who registered for the three-day conference (April 5-7), heard 25 speakers discuss trends in the industry and present case studies of company practices in specific areas of packaging.

Among these speakers were six from Monsanto, who in a panel session said that effective and economical packaging can be achieved only through coordination, control, and standardization. The panel described the company's complete packaging program, empasizing the importance of coordination both within the company and with suppliers, carriers, and customers.

Other Executives' Views

Edmund S. Childs, sales manager for polyethylene resins at Monsanto's plastics division, revealed that although 60% of today's polyethylene already is being grabbed up as packaging material, packagers' demands continue to grow faster than production capacities. Childs declared that current industry production capacity of this material stands at about 150 million pounds annually and promises more than twofold growth within the next 18 months. He thinks that as a packaging material polyethylene will grow even faster, and by 1955 packaging applications will absorb about 70% of the supply.

R. C. Evans, director of marketing for Monsanto's plastics division, also sees no letup in the demand for plastics as a container or wrap. He estimated that about 525 million pounds of plastics would be produced for packaging this year. At present cellophane and plastic coatings still constitute the greatest portion of the amount of plastics consumed for packaging. But, he went on, thousands of pounds of styrene, phenolics, and polyethylene are swelling the total of plastics used each year. He also stated that plastic packages are doing better than a $300-million-a-year business.

Another booster of polyethylene was T. W. Sharp, manager, flexible packaging division, Bakelite Co., who declared that about 600 million square yards of polyethylene film were used for packaging last year. This year he expects production to double as expanded facilities of various producers go into production.

The vacuum forming method, among the most recent developments in plastics, is already a major factor in plastic film packaging, according to Edward W. Ward, general sales manager of Celanese Corp.'s plastics division. Present demand for vacuum formed packages exceeds production capacity.

Seilon Plastic Production By Seiberling

SEILON rigid polyvinyl chloride plastic, produced by Seiberling Rubber Co., Akron, O., on a pilot-plant basis for more than a year, will go into commercial production this summer upon completion of a new plant at Newcomerstown, O. Production capacity during the first two years of operation is expected to be about 1,500,000 pounds annually. The plastic will be produced in four- by eight-foot sheets. Sheets and plates are made by laminating thin calendered sheets; while tubes, pipes, rods, and bars can be produced by extrusion.

The corrosion resistance, light weight, and strength of the plastic make it suitable for acid or chemical tank linings; acid ducts, vents, and trays; chemically resistant pipe and fittings, exhaust fans, valves, pumps, nuts, and bolts; oil and chemically resistant flooring; and photographic trays and equipment. In addition, Seilon has decorative value in displays and good potentialities for service as a material of construction.

CALENDAR

May	17-20.	Second Basic Materials Exposition and Conference. International Amphitheatre, Chicago, Ill.
May	19.	New York Section, SPE. Hotel Gotham, New York, N. Y. Washington Rubber Group. South Texas Section, SPE. Youngblood's Cafeteria, Houston, Tex.
June	3.	Rhode Island Rubber Club. Summer Outing. Metacomet Golf Club, East Providence, R. I.
June	4.	Miami Valley Section, SPE. Annual Golf and Picnic Meeting. Terrace Park Country Club, Terrace Park, O.
June	5.	Southern Ohio Rubber Group. Summer Outing.
June	7-10.	Sixth National Plastics Exposition and Annual Plastics Conference. The Society of the Plastics Industry, Inc., Public Auditorium, Cleveland, O.
June	8.	Buffalo Rubber Group. Summer Outing. Transit Valley Country Club, East Amherst, N. Y.
June	9.	Newark Section, SPE. Military Park Hotel, Newark, N. J.
June	10.	New York Rubber Group. Outing. Doerr's Grove, Millburn, N. J.
June	11.	Fort Wayne Rubber & Plastics Group. Summer Outing. Tippecanoe Lake Country Club, Leesburg, Ind.
June	12-13.	The Los Angeles Rubber Group, Inc. Summer Outing. Hotel Miramar, Santa Barbara, Calif.
June	14-18.	American Society for Testing Materials. Annual Meeting. Sherman and Morrison hotels, Chicago, Ill.
June	18.	Akron Rubber Group. Outing. Boston Rubber Group. Summer Outing. Andover Country Club, Andover, Mass.
June	20-24.	American Society of Mechanical Engineers. Pittsburgh, Pa.
June	21-25.	International Rubber Technology Conference. London, England.
June	23.	Rubber Division, C.I.C. Royal York Hotel, Toronto, Ont., Canada.
June	25.	Detroit Rubber & Plastics Group, Inc. Summer Outing.
July	13-15.	Plant Maintenance Show. Pan Pacific Auditorium, Los Angeles, Calif.
Aug.	3.	New York Rubber Group. Golf Tournament. Baltusrol Golf Club, Springfield, N. J.
Sept.	9.	Miami Valley Section, SPE. Annual Fall Outing. N.C.R. Old River Park, Dayton, O.
Sept.	11-13.	Division of Rubber Chemistry, A. C. S. Hotel Commodore, New York, N. Y.
Sept.	23.	Southern Ohio Rubber Group. Fall Technical Meeting.

Survey of Styrene Stock Packages

A SURVEY made of 33 molders of styrene stock packages by Monsanto Chemical Co.'s plastics division, Springfield, Mass., indicates that there is a suitable package available for nearly every item of retail merchandise. The survey revealed that the molders queried have about 300 containers in stock, including rectangulars, octagonals, squares, rounds, half-rounds, cylindricals, oblongs, and special shapes such as triangles, hearts, and "Buddha boxes." The stock packages are listed in a brochure published by Monsanto, which also includes data on packages made from Vuepak cellulose acetate.

Boltaron in Canada

BOLTARON polyvinyl chloride products, which include pipe and fittings, sheet, rod, and block stock, are now available in Canada for industrial use. H. N. Hartwell & Son, Inc., Boston, Mass., has announced the appointment of two Canadian distributors, Vibra-Lite (Quebec) Reg'd., Montreal, and A & A Distributors, Ltd., Vancouver, B.C. Additional outlet will be added in the near future.

PPMA Committee Chairmen

THE Proprietary Plastics Manufacturers Association, 5719 W. Chicago Ave., Chicago 51, Ill., through President Richard A. Winter, has announced the appointment of the following committee chairmen: standards, J. M. Jayne, Plas-Tex Corp.; ethics, Harris Brin, Loma Plastics, Inc.; public relations, D. L. Jocelyn, Plastray Corp.; accounting and finance, D. D. Lovitz, Bernard Edward Co.; codes, D. S. Poulton, Columbus Plastics Products, Inc.; membership, J. B. Mockenhaupt, Victory Mfg. Co.; and traffic, J. L. Sholkin, Beacon Plastics Corp.

Phenolics in Rubber

A TALK on "Phenolic Resins in Elastomers" by Clinton Braidwood, Schenectady Varnish Co., Inc., highlighted the afternoon technical session of the April 9 spring meeting of the Detroit Rubber & Plastics Group, Inc., held at the Detroit Leland Hotel, Detroit, Mich. A total of 172 members and guests heard Mr. Braidwood discuss the types, reactions, and applications of phenolics in various elastomers. The presentation included many interesting sidelights on the properties and uses of phenolics in rubber cements and other products.

A cocktail hour and dinner followed the afternoon session. More than 200 persons attended the dinner, which featured a showing of the hour-long color film, "The Man with a Thousand Hands," which describes the Kitimat project of Aluminum Co. of Canada, Ltd. This project included reversing the flow of rivers, driving a river tunnel through 10 miles of mountain, and dropping the river over an artificial falls down to a power plant which was built in a hollow under the mountain.

Scientific and Technical Activities

Fine Attendance Marks Louisville Rubber Division, A. C. S., Meeting; Whitby Named 1954 Goodyear Medalist

A VERY good registration of members and guests of the Division of Rubber Chemistry, A. C. S., marked the sixty-fifth meeting of the Division held in the Brown Hotel, Louisville, Ky., April 14 through 16. In addition to the 830 regular members and guests, about 75 wives were also guests of the Division for this meeting.

In his remarks at the first technical session on April 14, James C. Walton, of Boston Woven Hose & Rubber Co., and Division chairman, announced that G. Stafford Whitby, director of rubber research, University of Akron, had been selected by the Goodyear Medal Award committee headed by S. G. Byam, E. I. du Pont de Nemours & Co., Inc., as the 1954 Goodyear Medalist. Dr. Whitby will receive the Goodyear Medal and make his address at the sixty-sixth meeting of the Division to be held in New York, N. Y., September 14 through 16.

Dr. Whitby, who was born in England in 1887 and attended the Royal College of Science in the University of London, worked in the Far East in the early days of the rubber plantations and is credited with techniques for handling and coagulating rubber latex to obtain a uniform product, and for being the first to secure data on variations in yield from tree to tree. He received his doctorate from McGill University in Montreal, P. Q., Canada, where he did work on rubber accelerators and polystyrene.

In 1929, Dr. Whitby became director of the division of chemistry in the National Research Council of Canada laboratories in Ottawa. A former president of the Canadian Institute of Chemistry and the Canadian Chemical Association, he left Canada in 1939 and spent three years in England as director of the chemical research laboratory in the Department of Scientific & Industrial Research. He came to the United States in 1942 to become professor of rubber chemistry in Akron University and was later named director of rubber research. In 11 years of research under the government synthetic rubber program, Dr. Whitby has contributed to the identification of "popcorn polymer" and to production methods for LTP GR-S.

A meeting of the Division's 25-Year Club was held April 14; plant trips to Louisville's "Rubbertown", Brown-Forman Distillers Corp., and General Electric Appliance Park, on the afternoon of April 15, were enjoyed by many; and the Division banquet on the evening of the same day, at which Clarence E. Manion, former dean of the Notre Dame Law School, spoke, was a very enjoyable occasion. The Division's own Harry L. Fisher, this year's president of the American Chemical Society, also spoke briefly at the Division banquet.

Chairman Walton paid tribute on several occasions to the hard-working local committee on arrangements headed by Fred C. Wagner, du Pont, for its part in making such a fine meeting possible.

Abstracts of the technical papers presented were given in our March issue, and some further comment will be included in this report.

25-Year Club Luncheon

Allyn I. Brandt, B. F. Goodrich Chemical Co., was chairman of the 25-Year Club luncheon-meeting in Louisville. It was announced that the Club now has a membership of 385. A visitor from abroad, Tom Martin, managing director, Anchor Chemical Co., Ltd., of England, was next introduced.

Following the introduction of new members of the Club, members with longer than 25 years of service were asked to stand until by the process of elimination the member present at the Louisville meeting having the longest period of service in the industry and not previously having been so honored was determined. The honor in this instance went to Prosper E. Cholet, Allied Chemical & Dye Corp., for 44 years of service in the industry, and he was presented with a suitable memento of the occasion.

The chairman of the meeting asked the members to stand in a moment of silent tribute to two members who had passed on since the last meeting of the Club. These two were Charles Berlow, of Berlow & Schlosser, and Harry G. Eckhardt, of Lea Fabrics, Inc.

The chairman for the 25-Year Club meeting in New York in September will be Bruce Silver, of N. J. Zinc Co.

The Technical Sessions

In his opening remarks at the first technical session on April 14, Chairman Walton reported 100% attendance of officers and directors of the Division at the Louisville meeting. He thanked the authors of the papers to be presented and reminded the Division that deadline for the papers for the New York meeting is June 25.

The first paper on the program described a new class of alkylsulfenyl diothiocarbamate accelerators that show powerful accelerating action while at the same time they provide good scorch resistance. The authors of this paper were J. V. Svetlik, H. E. Railsback, and C. C. Biard, Phillips Petroleum Co.

In the next paper it was shown how a heliostat, or sun-follower, could be used to speed up the outdoor aging of rubber products. A second part of this paper dealt with the effect of various regions of the sun's spectrum on weathering. The authors were G. H. Cosner and Ray Thoman, Gates Rubber Co.

Natural rubber and GR-S compounds and blends of whole tire reclaimed rubber with these rubbers were tested for dynamic properties by five different methods by John Ball, Midwest Rubber Reclaiming Co. He found that by most of the test methods natural rubber with 25% reclaimed rubber had as low a hysteresis as the GR-S alone.

Some interesting studies on high solids synthetic latices prepared by adding more monomer and initiator to 25% total solids latices of varying particle size was reported by Maurice Morton and W. E. Gibbs, University of Akron. Small particle size latex seemed to be the best starting point although some increase in viscosity resulted in high solids latices prepared in this manner.

In a further study of oils used in making oil-extended synthetic rubber it was shown that narrow limits of viscosity, total nitrogen bases, and paraffins were necessary in specifications for such oils. Also, aeration of the latex before masterbatching with the oil minimized polymer breakdown without sacrifice of physical properties or processing. This paper was the work of W. K. Taft, M. Feldon, J. Duke, R. W. Laundrie, and D. Prem, Government Laboratories, University of Akron.

The vulcanization of W Types of neoprene with a combination of thiuram, guanidine, and sulfur provides a high degree of processing safety with no decrease in cure rate or physical properties of the vulcanizates, results desirable for present-day production requirements, according to R. M. Murray and D. C. Thompson of du Pont.

Factors important in testing abrasion resistance of tire tread compounds on the constant slip abrader were discussed by L. H. Howland, W. W. White, and W. E. Messer, Naugatuck Chemical Division, United States Rubber Co. Laboratory abrasion tests at various temperatures indicate that wear of LTP GR-S and oil-extended LTP GR-S increase with rising temperature, but that LTP GR-S extended with a synthetic resin retained its wearing qualities better at higher temperatures. Abrasion results on the constant slip machine correlate rather well with road tests, it was said.

Silicone rubber compounds reinforced with treated silica pigment having tensile strengths of 1850 to 2100 psi. and elongations of 850 to 950% were described in a paper by F. L. Kilbourne, Jr., Clinton M. Doede, and K. J. Stasiunas, Connecticut Hard Rubber Co. These compounds can be used at temperatures up to 400° F., and even higher for short periods of time. Silicone rubber with a molecular weight of around 400,000 must be used, however.

In a series of three papers by N. R. Legge and coworkers at the Kentucky Synthetic Rubber Corp., it was first shown that the incremental addition of divinyl benzene and regulator plus other changes in polymerization procedure could provide GR-S with improved mill shrinkage and good physical properties.

Incremental addition of modifier in GR-S polymerization reduced the amount of low molecular weight material and increased the oil capacity of the polymers and, in turn, their ability to absorb carbon black.

The Business Meeting

At the business meeting of the Division, Chairman Walton first asked that the members stand for a moment of silent tribute to those members who had died since the last meeting, or whose deaths had not previously been reported. The deceased members mentioned were Richard A. Crawford, The B. F. Goodrich Co.; Chas. Berlow; Harry G. Eckhardt; Harry L. Ericson, Continental Carbon Co.; Etzio J. Gioliot, Industrial Tape Corp.; George E. Griffin, Harwick Standard Chemical Co.; George W. Miller, W. J. Voit Rubber Corp.; Oscar Nelson,

United Carbon Co.; Chas. T. Schaffnit, Jr., Whitney Blake Co.; D. A. Shirk, Rare Metal Products Co.; Hugh Smallwood, United States Rubber; T. J. Starkie, Witco Chemical Co.; and Joseph P. Zak, Binney & Smith Co.

It was then explained by Mr. Walton that the Division officers wished to put the finance and budget committee on a long-term status in view of the increasing activities and responsibilities of the Division. This move would require a change in the by-laws so that the finance and budget committee members would be elected instead of appointed officers. It was also desired to make the term of service six years for members of this committee. A motion to make this change was made, seconded, and passed unanimously.

C. S. Yoran, Brown Rubber Co., chairman of the by-laws committee, then described the details of the changes in the by-laws required, and a motion was made, seconded, and unanimously approved that the necessary changes be made. New finance and budget committee members will be elected by the directors of the Division.

The report of the nominating committee headed by John T. Blake, Simplex Wire & Cable Co., was next made. Nominations for officers and directors from several of the areas of the sponsored local rubber groups were as follows: chairman, John M. Ball; vice chairmen, Arthur E. Juve, Goodrich, and John W. Snyder, Binney & Smith; secretary, Arthur M. Neal, du Pont; and treasurer, Amos W. Oakleaf, Phillips Chemical Co. For directors, the following men were nominated: *Akron*, L. M. Baker, General Tire & Rubber Co., and, D. F. Behney, Harwick Standard; *Boston*, Bernard H. Capan, Tyer Rubber Co., and Walter Edsall, Goodyear Tire & Rubber Co.; *Buffalo*, Howard E. Elden, Dunlop Tire & Rubber Co., and Paul Sick, Hewitt-Robins, Inc.; *Chicago*, B. W. Hubbard, Ideal Roller & Mfg. Co., and B. A. Kaufman, Lion Rubber Products Co.; *Fort Wayne*, C. E. Jackson, Paranite Wire & Cable, and Dan Reahard, General Tire; *Los Angeles*, Robert D. Abbott, R. D. Abbott Co., and B. R. Snyder, R. T. Vanderbilt Co.; *New York*, Joseph Breckley, Titanium Pigment Corp., and S. M. Martin, Jr., Thiokol Chemical Corp.

According to John J. Hoesly, Goodyear, chairman of the membership committee, the Division now has 2,238 regular members, 432 associate members, and 613 company subscribers to *Rubber Chemistry and Technology*, for a total of 3,283.

Chairman Walton reported that following the announcement at the September meeting in Chicago of the decision of the Division to discontinue the Division Library on March 1, 1954, he had received many letters and calls protesting this action. As a result, the steering committee in January rescinded the action of the executive committee in Chicago and voted to continue the Library until August 1, 1954, because sufficient funds were then available. In addition, it has been decided to investigate methods of obtaining outside help with a view to continuing the Library indefinitely with such funds as may be obtained on the outside and those that may be available from the Division.

A Library promotion committee for 1954 has been appointed to prepare a formal program for continuation of the library service and to act as a liaison group with The Rubber Manufacturers Association, Inc., one of the main sources of outside help for the Division Library. This committee consists of B. S. Garvey, Sharples Chemicals, Inc., chairman; R. P. Dinsmore, Goodyear; J. N. Street, Firestone Tire & Rubber Co.; F. K. Schoenfield, Goodrich; and G. H. Swart, General Tire.

G. Stafford Whitby

An operating budget for the Library for the next five years of $5,700 a year has been estimated.

In addition to the date for the next meeting in New York, September 14 through 16, the following dates and places have been decided upon for future meetings of the Division: May 4-6, 1955, Detroit, Mich.; November 2-4, 1955, Philadelphia, Pa.; May 16-18, 1956, Cleveland, O.; September 19-21, 1956, Atlantic City, N. J.; May 15-17, 1957, Montreal, joint with Rubber Division, C. I. C.; September 11-13, 1957, New York.

The Division Banquet

One of the surprises at the Division banquet held in the Brown Hotel on the evening of April 15, was the presentation to Chairman Walton by Arthur W. Grafton, Louisville attorney, of a Kentucky colonel's commission, "with all the rights and privileges thereof."

Dr. Fisher, A. C. S. president, spoke briefly on activities of the Society and mentioned its present annual budget of $4½ million.

Dr. Manion pointed out in his speech that chemists and other groups all over the country are devoted to their own "special interests," but said that nowhere had he found an organization bound together in the general interest of this country.

Concentration of government plays directly into the hands of Communists, and the Constitution and its doctrines of States' rights are the nation's best defense against Communism, he added.

Manion said that the Federal Government now owns one fourth of the land area of the United States and operates $30 billion worth of "private enterprise"—business that private industry could handle. He cited speeches of President Eisenhower to show that the President also fears a constant drift toward central government.

Other features of the banquet program were organ music by Herbie Koch and a short, but very enjoyable variety show arranged for by the local committee.

ASME Rubber & Plastics Division's Pittsburgh Meeting

THE Rubber & Plastics Division of the American Society of Mechanical Engineers will hold two half-day technical sessions, one on rubber and one on plastics, at the semi-annual meeting of the parent Society in Pittsburgh, Pa., during the week of June 21. The Rubber & Plastics Division meeting will be in the William Penn Hotel on June 22. The chairman of the Division is Allen G. Gifford, Lord Mfg. Co., and the secretary is Gordon B. Thayer, Dow Chemical Co. For each of the technical sessions, however, a separate chairman and vice chairman are appointed.

The papers on plastics will deal with laminates and the weather aging of plastics materials. The papers on rubber comprise a symposium on O-rings, with special reference to design, compounding, and processing. Details of the program follow:

TUESDAY MORNING—JUNE 22

CHAIRMAN, MAURICE MORTON, UNIVERSITY OF AKRON

VICE CHAIRMAN, DANIEL T. DOWNES, PITTSBURGH PLATE GLASS CO.

"Dielectric Fatigue Properties of Thermo-Setting Laminates," Norman A. Skow, Synthane Corp.

"Impact Thermo-Setting Plastics with Responsibilities," Paul E. Fina, The Fiberite Corp.

"Weather Aging of Styrene and Phenolic Plastics," C. Howard Adams and J. R. Taylor, Monsanto Chemical Co.

TUESDAY AFTERNOON—JUNE 22

CHAIRMAN, WALTER TEPPER, MARTIN RUBBER CO.

VICE CHAIRMAN, EDWARD T. WANDERER, ALUMINUM CO. OF AMERICA

"O-Ring Seals in the Design of Hydraulic Mechanisms," David R. Pearl, Hamilton Standard Division, United Aircraft Corp.

"Compounding Principles Involved in the Production of O-Rings," Douglas S. Messenger, Garlock Packing Co.

"Molding Procedures for the Manufacture of O-Rings," E. L. Carlotta, Parker Appliance Co.

Werkenthin Guest Speaker

EIGHTY members and guests of the Washington Rubber Group attended the March 17 meeting, held in the Pepco Auditorium, Washington, D. C., and featuring a talk on "Some Elastomer Uses in Naval Ships," by T. A. Werkenthin, Navy Bureau of Ships.

The speaker discussed and showed slides of the many applications of rubber in naval vessels, including coatings of all types; matting; calking compounds; battery compartment lining; propeller shaft coverings; strip-type main propulsion bearings; mountings; expansion joints; gaskets; hose; lifesaving and safety equipments; and others. The importance of rubber is exemplified by the fact that a carrier of the *Midway* class requires about 75,000 pounds of rubber; a battleship like the *Missouri* uses about 55,000 pounds; a submarine requires about 48,000 pounds; and a destroyer uses about 4,500 pounds.

Rubber Chemistry Division, C.I.C., June 23, Toronto Meeting

THE Rubber Chemistry Division of the Chemical Institute of Canada has scheduled a one-day meeting for June 23 at the Royal York Hotel, Toronto, Ont., according to an announcement received from G. D. Stevens, Goodyear Tire & Rubber Co. of Canada, Ltd., chairman of the Division. This meeting will be a part of the thirty-seventh annual conference of the Institute to be held on June 21, 22, and 23, in Toronto. The Conference will feature a Chemical Exhibition at which the latest in chemical process equipment, scientific instruments, chemicals, and scientific books will be displayed.

In addition to a technical program of eight papers, the Rubber Chemistry Division will have a banquet at 7:00 p.m. in the Tudor Room of the Royal York Hotel, at which B. B. Hillary, executive assistant of Dow Chemical Co., will be the speaker.

American rubber technologists and others interested in the program of the Rubber Chemistry Division, C. I. C., are invited to attend this meeting as well as other meetings of the Institute. The program and abstracts of the Rubber Division meeting follow:

WEDNESDAY MORNING, JUNE 23
G. D. STEVENS, PRESIDING

9:30 a.m. **Promoters for the Reaction of Carbon Black with Rubber. Kenneth W. Doak,** George H. Ganzhorn, Bernard C. Barton, United States Rubber Co., Passaic, N. J.

Heating unvulcanized mixtures of rubber and carbon black change the physical properties of the resulting vulcanizates, giving increased electrical resistivity, reduced hysteresis and hardness, higher modulus at high elongations, and increased abrasion resistance. These effects are believed to be the result of improved dispersion of carbon black, caused by a chemical reaction between rubber and carbon black.

The rate of reaction depends on the time, temperature, degree of unsaturation of the rubber, and the type of black. A variety of chemical promoters, such as organic peroxides, N-halogenated imides, aromatic nitroso compounds, certain quinones, and active halogen compounds like hexachlorocyclopentadiene and hexachlorophenol, increase the rate of reaction.

Peroxides are especially effective in *Hevea* rubber and GR-S containing channel black and, when properly used, give the expected improvements in physical properties without adversely affecting tensile strength. N-halogenated imides are particularly effective in Butyl rubber containing channel or furnace black. It is suggested that these promoters initiate allylic radicals on rubber chains, which can react with carbon black to form primary valence bonds.

10:00 a.m. **Low-Temperature Plasticizers. M. A. Pollack,** W. C. Hardesty Co., New Toronto, Ont.

In order to compound elastomers which will not stiffen and crack in the cold, it is necessary to select plasticizers very carefully. Plasticizers differ widely in their effectiveness at low temperatures, and the reasons for these variations are looked for in the fundamental properties of the plasticizers.

Contrary to what might be expected, the freezing point of the plasticizer is found to have no significant bearing on the cold resistance of a polyvinyl chloride compound.

On the other hand, the viscosity and viscosity index are shown to be directly correlated with low-temperature performance. The most desirable combination in a plasticizer is a low-viscosity and a high-viscosity index.

This same combination has long been in great demand in the lubricant industry, and we now find some of the best low-temperature plasticizers going into the production of lubricants, particularly for aircraft.

10:30 a.m. **Kinetics and Cross-Linking Efficiency in Mercaptobenzothiazole Vulcanization. Irving Auerbach,** Goodyear Tire & Rubber Co., Akron, O.

In a previous publication[1] a kinetic expression was presented for the vulcanization of GR-S. This expression suggested a secondary reaction between combined and uncombined sulfur, which has been substantiated experimentally. Rubber samples, cured with a mercaptobenzothiazole formulation, were extracted to remove unreacted accelerator and sulfur, which materials were then allowed to react with additional sulfur. The rate of sulfur uptake was greater than that of the controls, and the kinetic data obtained agreed substantially with that given in the rate equation.

Cross-linking efficiency, i.e., the number of sulfur atoms per cross-link, varies with accelerators and formulation conditions. A study has been initiated to determine the factors which influence this efficiency with mercaptobenzothiazole formulations. Cross-links are most reliably determined by swelling volume techniques, but because this method is time consuming, a procedure has been evolved whereby cross-linking efficiency is obtained from modulus data. These values are in agreement with those obtained by swelling volume measurements.

The kinetic expression previously referred to suggests that increasing the mercaptobenzothiazole concentration should improve the cross-linking efficiency. This theory was confirmed when an increase of accelerator from one part to five parts changed the number of sulfur atoms per cross-link from seven to three. The effects of zinc oxide, zinc mercaptide of mercaptobenzothiazole, and zinc laurate on cross-linking efficiency were also determined.

Whereas the cross-linking efficiency is constant throughout the curing process for GR-S, it varies in natural rubber. The efficiency is best during the initial curing stages and is apparently dependent on the extent to which the rubber is broken down on the mill.

11:00 a.m. **Carboxylic Nitrile Rubber —A New High-Strength Elastomer.** H. P. Brown, The B. F. Goodrich Co., and **N. G. Duke,** B. F. Goodrich Chemical Co., Cleveland, O.

Carboxylic bearing monomers have been combined with butadiene and acrylonitrile to give nitrile rubbers of exceptional stress-strain properties, both for vulcanizates of pure gum stocks and of latex films. Properties of both dry rubber and latex forms of such polymers are discussed, and comparisons made with their normal nitrile counterparts.

The carboxylic polymers show more versatility than normal rubbers with respect to methods of vulcanization. Excellent cures can be obtained by the use of bivalent metal oxides or salts alone. Certain vulcanizate properties, including compression set, are improved by using a combination metal oxide-sulfur type of curing system. The mechanism of bivalent metal vulcanization is discussed briefly.

The oil resistance of the carboxylic nitrile rubbers is, in general, better than the corresponding normal nitrile rubber. Other properties discussed include compatibility with other rubbers and resins, processing characteristics, compression set, water resistance, and adhesive properties. Information on the unusual penetrating power of the latex and the resistance of the latex films to dry cleaning fluids, such as trichloroethylene, is also presented.

In reviewing the physical and chemical characteristics of the latex, attention is given to techniques for adjusting the pH of the latex and improving its mechanical stability. Latex films can be formed by conventional casting or coagulant dip methods. A number of commercial applications for the carboxylic nitrile rubbers, where their high strength and good aging properties can be used to advantage, are suggested. The strength, adhesive properties, and high penetrating power of the latex should be of interest to the textile, paper, and leather industries.

Two carboxylic nitrile latices, Hycar 1571 and 1572, are commercially available at the present time. The dry rubbers are not available, and their availability on a commercial scale is not anticipated in the near future.

11:30 a.m. **Business meeting of the Division.**

WEDNESDAY AFTERNOON, JUNE 23
HAROLD LOISELLE, PRESIDING

2:00 p.m. **Ozone Resistance of Butyl Vulcanizates. D.** C. Edwards and **E. B. Storey,** Polymer Corp., Ltd., Sarnia, Ont.

A study of the cracking behavior of Butyl rubber vulcanizates exposed under static strain in an atmosphere containing 25 parts per hundred million of ozone and including the development of a means of rating the severity of cracking of triangular strip specimens has been made.

The compounding factors studied include raw polymer unsaturation, mixing and processing variables, state of cure, plasticizer and black loadings, and effect of antioxidants and waxes. Cracking increases moderately with increasing raw polymer unsaturation and is markedly reduced with increasing state of cure. Black loadings in excess of 40 parts per 100 RHC are desirable. Plasticizers are generally detrimental to ozone resistance; the effect is proportional to plasticizer loading, but varies considerably between plasticizers. The antioxidants tested were all of some benefit, but none offered complete protection at conventional loadings. Variations in laboratory mixing, extruding, and curing techniques caused no substantial change in cracking behavior of the vulcanizates.

Through careful choice of plasticizer and with a suitable state of cure, it is possible to prepare low-cost, highly ozone-resistant compounds without reliance on waxes or excessive antioxidant loadings.

2:30 p.m. **Carbon Blacks for the Rubber Industry. William M. Meeker,** Canada Carbon Co., Toronto, and Leslie D. Carver, Continental Carbon Co., New York, N. Y.

Carbon black may be considered as one of the significant factors contributing to the concept of pigment reinforcement of rubber. Prior to 1920 much reliance was still placed on sulfur in the vulcanization reaction so that a considerable part of the reinforcement benefit was lost through degradation of the rubber. Since 1913, when carbon black was first used as a reinforcing pigment, carbon black production has kept pace both in quantity and quality with the increasing use of rubber,

[1] *Ind. Eng. Chem.*, 45, 1526 (1953).

as demonstrated by the newer and more efficient blacks developed through research.

Channel, furnace, and thermal are the principal types of carbon black. Channel blacks are prepared from natural gas by the controlled incomplete combustion of small flames impinging on a metal channel. Furnace blacks are produced by the controlled incomplete combustion of natural gas and/or oil introduced into furnaces where the reaction takes place. Thermal blacks are manufactured by the alternate heating and cracking of natural gas and air in a furnace. A fourth type of black, acetylene black, is obtained by cracking acetylene gas by exothermic decomposition.

The evolution of the various grades of carbon black has produced blacks with widely different properties so that today we have tailor-made varieties and subvarieties which offer unlimited applications and possibilities. In the course of theoretical as well as practical experimentation it has been proved that carbon black is the ideal reinforcing agent since it is chemically inert, yet physically active; easily "wet" by rubber, yet forming bonds between carbon and rubber equal in adhesive power to those existing in the rubber mix itself.

3:00 p.m. **Influence of Various Weathering Factors in Ozone Cracking of Natural and Synthetic Rubbers.**[2] **W. G. Mayes,** Firestone Tire & Rubber Co., Akron.

A study has been made of the relation between the depth of ozone cracking and such variables as: (1) ozone exposure temperature, (2) type of rubber compound, (3) type and extent of elongation, (4) wax content of the stock, (5) ozone concentration, (6) time of ozone exposure, (7) the amount of light during ozone exposure, and (8) state of cure.

In a comparison of the ozone resistivities of compounds based on several commercial polymers, the following order of decreasing resistivity was found: (1) Butyl rubber, (2) neoprene, (3) nitrile rubber (Butaprene NSP-98), (4) *Hevea* rubber, and (5) GR-S. This order of resistivity was found to hold over the temperature range of —20 to +60° C.

In testing the influence of ozone exposure temperature on the depth of ozone cracks (at an ozone concentration of 25 pphm.), in the range from —20 to +60° C., it was found that the most severe ozone cracking took place at 40° C.

The presence of 2% wax in *Hevea* rubber or GR-S was found to afford no protection against ozone cracking at temperatures of 40° C. or higher, presumably because the wax becomes soluble in the compound at these temperatures.

Light was found to decrease the extent of ozone cracking on a compound under either static or dynamic elongation.

Depth of ozone cracking is a minimum at optimum cure. Ozone cracking and the molecular weight between cross-links were found to be linearly related—the lower the molecular weight between cross-links the shallower the ozone cracks.

3:30 p.m. **Statistics—A Tool in Testing Rubber. Robert D. Stiehler,** National Bureau of Standards, Washington, D. C.

The value of statistics in the investigation and testing of materials is becoming more and more evident. Statistical techniques provide the tools required by the technologist for the efficient and effective planning or design of experiments, assessing the validity of the data, interpreting the experimental results, and comparing the relative merit of methods of test.

Some of the applications of these techniques at the National Bureau of Standards to the testing of rubber are discussed, including the measurement of tensile strength, stress and strain of GR-S vulcanizates, viscosity of polyisobutylene solutions, and the tread wear of tires. A brief discussion of the behavior of measurements, precision, sensitivity of test, random errors, and systematic biases is also given.

Tire testing is used to illustrate the economic aspect of testing. In this connection, the tire tester under development at the National Bureau of Standards is briefly discussed.

[2] Research supported by contract with U. S. Army Ordnance Department.

Akron Group Carbon Black Symposium Details

THE papers presented and the questions asked and answers given at the Akron Rubber Group symposium of January 29, held at the Mayflower Hotel in Akron, O., are now available and are presented herewith. A preliminary report of this meeting appeared in our March issue, page 791.

More than 500 members and guests of the Group attended the carbon black symposium, presided over by R. P. Dinsmore, vice president, Goodyear Tire & Rubber Co. Panel members, in addition to Dr. Dinsmore, comprised C. A. Carlton, J. M. Huber Corp.; G. C. Maassen, R. T. Vanderbilt Co.; I. Drogin, United Carbon Co.; Leslie Carver, Witco Chemical Co.; Merton Studebaker, Phillips Chemical Co.; John Snyder, Binney & Smith Co.; F. H. Amon, Godfrey L. Cabot, Inc.; and, L. E. Sperberg, Sid Richardson Carbon Co.

The symposium consisted of short talks by the various members of the panel, which are presented first. Questions and the answers obtained are reproduced following the talks. Unfortunately several questions answered by the moderator, Dr. Dinsmore, were not provided with the transcript and, therefore, do not appear in this report.

The Manufacture of Channel, Gas Furnace, and Oil Furnace Carbon Blacks

C. A. Carlton[1]

CARBON black, generally, is made by two basic methods: the contact method and the furnace method. In the contact method, black is deposited when a flame impinges upon a relatively cold surface. In the furnace method, black is produced by incomplete combustion or thermal decomposition of hydrocarbon fuel stock. The contact method can be subdivided on the basis of the contact surface; the furnace method can be subdivided on the basis of the mechanism of carbon foundation, that is, formation by partial or incomplete combustion or by thermal decomposition.

In both contact and furnace methods a substantial portion of the total hydrocarbons used is consumed by combustion to supply the heat necessary to decompose the balance to carbon. In the case of channel black the heat is formed at the outer surface of the flame, and the cracking takes place in the inner portion of the flame. In the case of the furnace process the burner section of the furnace supplies the heat to crack the feed stock to carbon.

During the year of 1953 the contact method accounted for 30% of the total production of carbon black and for 49% of the high reinforcing blacks including channel, high abrasion furnace, and super abrasion furnace blacks. Prices of rubber grades range from 3½-13½¢/lb. in bags, f.o.b. point of production.

Contact Method

The chief type of black made by the contact process is channel black. The name channel is used because the flame impingement or contact surface is a section of channel iron.

A channel black production unit is composed of a group of from 30 to 100 rectangular burner houses, constructed of sheet iron, placed side by side in rows so that the production from each house can be conveyed to a common screw conveyor running in front of each row of houses. A typical burner house size is 130 feet long, 10 feet wide, and nine feet high.

Each burner house contains 10 parallel steel channels, seven or eight inches in width and nearly the length of the house, mounted in one system on a track; so

[1] J. M. Huber Corp., New York, N. Y.

they can be moved slowly back and forth lengthwise. Fan shaped flames, produced by burning natural gas through lava tips, are impinged upon the bottom surface of the slowly moving channels. Fixed scrapers and hoppers located every 6-8 feet across the channels collect the black and drop it into a screw conveyor at the bottom of the house, thus moving the black from each house to a central conveying system. The black is then conveyed to the finishing area where it is degritted, pelletized, screened, and packaged in bags or bulk hopper cars.

The properties of channel black are governed by the following basic variables: (1) composition of the gas burned, (2) amount of gas burned per tip, (3) design of the burner tips used, (4) slot width, spacing, and distance from the channels of the burner tips, (5) width, spacing, and speed of travel of the channels, (6) distribution of gas to the burner tips, (7) design of burner house to produce steady uniform flames, and (8) drafting of the burner house to control temperature and smoke concentration.

Furnace Method — Partial Combustion

A furnace plant for the production of carbon black by the partial combustion process is made up of a combustion chamber or furnace, a cooling tower, an electrical precipitator and several cyclone collectors.

Natural gas or vaporized liquid hydrocarbon is fed continuously into a furnace along with a controlled amount of air. The cracking stock is partially consumed in the ensuing reaction, and carbon black, hydrogen, carbon oxides, and water are formed. The "smoke" stream is then cooled by water quench, and the carbon black separated from the gases by electrical precipitation and cyclones. Bag filters may also be used for black collection.

A wide range of carbon blacks can be produced by the furnace process, ranging in particle size from the coarsest semi-reinforcing furnace black to the finest super abrasion furnace black.

The most important variables governing the quality of the black produced are (1) furnace design, (2) type of cracking stock used—gas or oil, (3) composition of cracking stock used, particularly of the liquid hydrocarbons, (4) ratio of gas to oil if both are used as cracking stock, (5) ratio of air to hydrocarbon, (6) degree of combustion, (7) residence time in furnace, (8) temperature, (9) degree of turbulence in the cracking zone, and (10) rate and degree of cooling of the "smoke" stream.

The one basic difference between the carbon blacks produced by the contact and furnace processes lies in the fact that in the contact process the black is subjected to relatively high temperatures in the presence of air; whereas in the furnace process the carbon is formed and collected in a reducing atmosphere. The combined oxygen in channel black accounts for its slower rate of cure. Furnace blacks are substantially free from combined oxygen.

Use and Application of Thermal Blacks in Various Rubber Hydrocarbons

G. C. Maassen[2]

THERMAL blacks are made by cracking natural gas. Briefly, the process consists in passing natural gas over a checker work of preheated refractory bricks. This action causes the gas to decompose into carbon and hydrogen. By controlling the process, it is possible to make either medium thermal black or fine thermal black.

The blacks produced by this method have particle sizes much greater than those obtained by the channel or furnace processes. By comparison, MT black has an area of one-twentieth that of channel black, and FT black an area of about one-sixteenth that of channel black. Because of this great difference in particle size, it becomes obvious that these thermal blacks are not reinforcing blacks in the same sense that the channel blacks are. The lack of reinforcement of thermal blacks permits them to be used through heavier loading to a greater advantage than hard blacks in certain applications.

Blacks made by this process are nearly neutral or slightly alkaline; whereas channel blacks are definitely on the acid side, and furnace blacks are definitely alkaline. Therefore in compounding these blacks it is not necessary to compensate in the accelerator dosage for the retarding or activating effect which the black may have.

MT black was the first of this type of black introduced and found use in rubber because of its low pound cost and low gravity. For an equal volume loading it does not deteriorate a rubber stock so much as whiting; nor does it stiffen so much as clay. As a result, it is possible to use greater quantities of MT black in any given stock to approximate the results obtained from either of these mineral fillers; and, accordingly on a volume cost basis, it is competitive with whitings and clays. Thus by using MT black it is possible to reduce the rubber content of a stock, and in effect the black is being substituted for rubber at a lower cost.

Stocks made from MT black do not become stiff in the uncured state and, therefore, process without scorching.

FT black processes similarly to MT black. Stocks using the former are of somewhat lower modulus, somewhat higher tensile, and of greater tear resistance which caused the conversion from red natural rubber inner tubes to black inner tubes. Before the advent of GR-I (Butyl rubber), all high-quality inner tubes were black and contained 40 to 50 parts FT black. Natural rubber truck and bus inner tubes being made today are still using FT black in those proportions.

The low modulus and high tear resistant properties of FT black are used to advantage in compounding hose covers, belt covers, footwear uppers, and other soft goods where tear resistance in service is of importance.

In GR-S the same relation between MT and FT blacks holds, but to a lesser degree.

In neoprene both MT and FT blacks can be used to advantage. Since neoprene compounds are designed primarily for oil resistance, and since the hydrocarbon portion of the compound is usually the only portion which suffers deterioration due to the swelling effects of the oil, it is desirable to keep the hydrocarbon portion to a minimum. It is, therefore, very desirable to be able to load such a compound as highly as possible without unduly affecting the physical properties. The thermal blacks have the further advantage of not generating excessive heat during processing to cause scorch. Neoprene compounds loaded with thermal blacks will tolerate mc punishment in mixing, calendering, and truding than similar compounds us harder blacks as fillers.

The above factors involved in using thermal blacks with neoprene also apply to the nitrile rubbers. In the nitrile rubbers tear resistance is not so good as in neoprene, but that characteristic does not seem to be affected by the blacks alone.

In Butyl rubber MT and FT blacks seem to function similarly to clay. For use in inner tubes where most of the Butyl rubber has been used, the blacks do not reinforce the uncured compound sufficiently to permit the desired handling ease. As more work is done toward adapting Butyl rubber to applications other than inner tubes, it is hoped that this type of black will find its niche just as it has done in the other polymers.

MT and FT blacks have always found wide application in reclaim compounds; MT black particularly because it is a low volume cost filler, and, where reclaim is used for purposes other than processing, low volume cost is often the reason.

In summarizing, it can then be said that the thermal blacks are used because they are low-volume cost, high-quality fillers, and high loadings can be used without proportionate reduction in mechanical properties. For natural rubber inner tubes the fine thermal blacks are a "must."

[2]R. T. Vanderbilt Co., New York.

The Use and Application of SRF Blacks in Various Rubber Hydrocarbons

I. Drogin[3]

SEMI-REINFORCING furnace black is a type of black which fulfills many requirements. It is made from natural gas which is sometimes enriched with oil in order to increase production. The black is pelleted either wet or dry and is shipped either in bags or in bulk in enclosed hopper cars. SRF black is an economical

[3]United Carbon Co., Charleston, W. Va.

form of carbon black. Its present market price is 4½¢ a pound, as compared with 5-13.5¢ a pound for other types of black which are more reinforcing. There are five producers of SRF black, marketing eight different brands, including the type NS, which does not bleed in rubber or stain enamel.

In general, the characteristics of SRF black are as follows. It has a surface area from 42 to 20 square meters per gram and a mean particle diameter of 70 to 160 millimicrons. It has a low color, a high nigrometer index, low oil absorption, and low iodine adsorption. It is alkaline, having a pH of about 9. It has less than 1% volatile matter.

Outstanding among the physical and chemical properties which make SRF black an ideal carbon black pigment, are softness, which gives a remarkable ease of dispersion and processing; good aging at low- and high-volume loadings; and low volume cost. A predominant characteristic of compounds containing SRF is their superior rubbery feel and flexibility, even with high-volume loadings.

SRF black has a high loading capacity; it is cool mixing, easy processing, relatively low in Mooney, moderately fast in extrusion, smooth in appearance, long in scorch time, and not too-fast curing. Its cured stocks have low modulus, moderate tensile strength, high elongation, low durometer, high resilience, good tear, low heat build-up, low permanent set, good resistance to flex, moderate resistance to abrasion, superior aging qualities, and improved resistance to oil, acids, alkalies, solvents, and steam.

SRF black has a diversity of uses. It is a vital ingredient in tire compounds. It is an ideal body ply type of black where its low heat build-up, high resistance to flex, and moderate stiffness are of importance. For the same reason this type of black is favored in inner tread, cushion, and squeegee-type compounds, sidewalls, and bead insulation. Heavy loadings of SRF black can be used safely in the outside tread also.

The high resilience, moderate resistance to abrasion, and good aging properties of SRF black make it a primary choice for friction stock to be used on bead covers, flippers, and chafers. Processing is easier, extruding uninterrupted, adhesion to the wire better, and bead compounds are far more effective. High loadings are possible at low volume costs as well as accelerator savings. For every job there is the best black, and for bead insulation SRF black shows superior properties.

SRF black is also popular in mechanical goods; in the tube, friction, and cover of a wide variety of hose; in all types of waterproof footwear, boots, overshoes, uppers, soles, and heels; in insulated low-cost wire jacket stocks, refrigerator gaskets, automotive molded and extruded parts, rubber coated fabrics, belts, windshield rubber, sealing strips, fan belts, and literally in thousands of mechanical parts, some obscure, but all important.

Insulated wire will tolerate rough treatment when made with SRF black. The black, with the addition of proper-type waxes, makes wire jacket stocks last longer without premature cracking and tear. The properties of SRF black make it easy to tube wire jackets smoothly and help them hold their shape.

SRF black in combination with fast extrusion black (FEF or HAF) in Butyl inner tubes promotes cool running, smoother finish, less stiffening, and easy processing.

SRF black footwear compounds produce overshoes, boots, soles, and heels which are remarkable for their flexibility, resilience, aging properties, and freedom from cracking. This black gives soles and heels just the proper degree of abrasion resistance, tensile strength, aging properties, and "snap" for constant flexing.

When higher volume loadings are recommended, these may be made with SRF black at low volume cost for the compound without appreciable impairment to many of its properties. Its low compound cost and high loading capacity make it desirable for many types of mechanical goods.

SRF black is ideal as a filler and also to reinforce moderately nitrile and neoprene rubbers where high loading capacity may be used at the same time.

Since some compounds are more sensitive to variations in the quality of SRF black, it is important that such black be supplied from regularly approved sources which can furnish black that will impart the desired characteristics to the finished products.

High Modulus Furnace Blacks in Various Rubber Hydrocarbons

L. D. Carver[4]

THE introduction of high modulus furnace black marked a significant step in the evolution of carbon black development. The first commercial grades of furnace blacks offered to the rubber industry were the semi-reinforcing blacks. Following this a growing interest was expressed for a furnace black with greater power of reinforcement, and the introduction by the carbon black industry, about 1942, of HMF black was the next step in this direction. This black is characterized by smaller particle size and greater reinforcement than its predecessor, the SRF blacks. HMF black has a particle diameter of from 50 to 70 millimicrons, is alkaline with a pH of about 10, and has somewhat less than 1% volatile matter. It will be remembered that HMF black was particularly helpful when hot GR-S was first introduced in tire compounds.

HMF black is produced by the incomplete combustion of natural gas, or a combination of natural gas enriched by higher petroleum hydrocarbons. There are five producers of HMF black. It is prepared for rubber compounding in the pelletized form by both a wet and a dry method and is shipped in bags or tank cars the same as other types of furnace blacks.

HMF black produces a higher modulus than SRF black in both synthetic rubber and natural rubber. This black also gives improved tensile strength, better tear strength, and improved abrasion as compared with the semi-reinforcing type, along with good aging at both high- and low-volume loadings. Practical applications for HMF blacks have covered a wide range of uses throughout the rubber industry. This black has been used to an appreciable extent in numerous mechanical goods, natural rubber footwear, and Butyl tubes, tire treads, and carcass and camelback, particularly in blends with channel and other blacks. HMF black found probably its greatest utilization in synthetic and natural rubber tire carcass compounds. Subsequent developments in carbon black have encroached appreciably upon the field of HMF black application; however, it finds rather extensive acceptance, particularly in the field of tire body and carcass compounding. Another influencing factor in this respect has been the synthetic polymer development that has taken place since the introduction of HMF black, particularly the many improvements since the original hot GR-S.

Practical applications for HMF blacks still cover a considerable range of uses throughout the rubber industry.

In natural rubber—tire carcass compounding, rubber boot uppers, and numerous mechanical goods.

In GR-S—tire carcass compounding and rubber boot uppers.

In neoprene—good physical properties are imparted even at high loadings.

In conclusion it may be said that, in general, an HMF black imparts higher physical properties and superior abrasion resistance than do the other gas furnace blacks.

The Use and Application of HAF Black in Various Rubber Hydrocarbons

Merton L. Studebaker[5]

HIGH abrasion furnace black, abbreviated HAF, was first commercially produced in 1947. At that time channel black was the dominant black used in tire treads. When HAF black was introduced, it was felt that it might eventually replace most of the channel black then consumed in tread stocks. It was a natural compounding material for synthetic rubber treads. HAF blacks were found to be superior to channel blacks in hot and cold GR-S in two important respects: first of all,

[4] Witco Chemical Co., New York.
[5] Phillips Chemical Co., Akron, O.

because they alleviated the very troublesome cracking of hot and cold GR-S treads containing channel blacks; and, second, because they improved the resistance to tread wear by approximately 20% under normal driving conditions. Under severe test conditions these improvements are much greater. As a result, HAF black is used in virtually all first-line passenger tires at the present time. Furthermore in the last two years most tire manufacturers have converted from channel black to HAF black in natural rubber truck tire treads. Cracking of natural rubber-channel black treads has been a problem, and it was common practice to blend HMF blacks with the channel blacks to reduce the cracking. This reduced the abrasion resistance of the treads. HAF blacks were found to alleviate the tread cracking without sacrificing abrasion resistance. In fact, natural rubber-HAF treads seem to be very slightly superior to the 100% channel black-natural rubber treads in abrasion resistance.

Government tire test results indicate that the effects of carbon black are independent of the type of rubber, and that HAF treads wear about 14% longer than treads containing channel black. Our tests have indicated, however, that the improvement in tire mileage due to replacement of channel black with HAF black is considerably greater in GR-S type rubber than in natural rubber. I believe that is in accordance with the experience of tire manufacturers, generally. Very few tire tests, however, are conducted in which the carbon black is the only variable, and this procedure may account for this discrepancy.

Physical tests on HAF blacks show that their particle size is similar to that of the EPC blacks, about 300 Å units in diameter. They have surface areas of about 80 square meters per gram. Their oxygen content is generally between ½ and ¾%. Channel blacks have roughly five times that amount. The HAF blacks are relatively hydrophobic, and the pH of their suspensions is about 9.

In rubber the HAF blacks give greater modulus and abrasion resistance values than the channel blacks. The tensile strength and elongation values are generally lower.

The interest in the newer blacks prompts me to give a comparison between blacks as indicated by our company's tests. This is somewhat hazardous because such values are quite dependent upon tire compounding, manufacturing and test conditions, etc. However we all have figures which we carry in our heads to use in comparing blacks. These are mine. They are based on the data available to me.

In Natural Rubber Truck Treads	In LTP GR-S Passenger Treads
HAF 100	HAF 100
EPC 95	EPC 83
ISAF 105	ISAF 110
SAF 110	SAF 130

Such figures, of course, are subject to change with further compounding developments and additional tire tests.

Much of the production of HAF black is shipped in hopper cars.

The Use and Application of FEF Black in Various Rubber Hydrocarbons

F. H. Amon[7]

FAST extruding furnace black, represented by the symbol FEF, is the first of three oil furnace types to be described at this panel session. Liquid hydrocarbons constitute the essential raw material for the manufacture of FEF black. Natural gas is commonly used as an auxiliary fuel, but is not essential to the process.

FEF black differs from HMF black not so much by a finer particle size as by a very much higher structure. This structure manifests itself by a very much higher oil absorption, by the property of flattening out rubber, and by a very high modulus. With an intermediate particle size and very high structure, FEF black has a pronounced reinforcing effect on rubber. High loadings are uncommon owing to both particle size and structure influences.

Uses of FEF black are based largely on its remarkable processing characteristics. In extruded rubbers it gives low die swell and dimensional stability; in milled, calendered, or extruded rubber it gives smoothness of surface. As a pigment for taming an unruly GR-S, it has no equal. Reinforcement of the rubber is at a high level and amply justifies the other name, medium abrasion furnace (MAF) black which has been assigned to it by some.

The extent of the use of FEF black is one proof of its value in rubber compounding, and use has followed production closely. First production was in 1943; production in 1945 was 50 million pounds; in 1947, 100 million pounds; in 1952, 194 million pounds; and in 1953, 213 million pounds.

The applications of FEF black in rubber are many and varied both in respect to end-product and to kind of polymer. The great value of FEF black for improving the processing of GR-S stocks for mechanical goods was early recognized. The reinforcement level was sufficient for most industrial products. For footwear, FEF black has the same advantages in high-grade compounds and has a special value in producing a smooth surface on GR-S products which are not cured in molds.

For automotive products, rubber must often be extruded to extremely accurate dimensions and into intricate shapes. Low die swell and dimensional stablity plus fast cure and fast extrusion are valuable characteristics of FEF black in insulated wire stocks. Incidentally, fast extrusion is not the dominant characteristic of this carbon black; it is the property of flattening out GR-S, and giving low die swell, which gives FEF black its special place in the list of carbon blacks.

In tires, FEF black is used to advantage in tread base and sidewall, where smooth extrusion, medium high reinforcement, and low hysteresis are desired. In tire carcass stocks, FEF black provdes high modulus, low hysteresis, and smooth calendering. FEF black is used in conjunction with more reinforcing blacks to give better extrusion and better appearance in camelback. The outstanding application of FEF black is in Butyl inner tubes. As the only or principal pigment in Butyl tube stock, FEF black gives smooth and fast extrusion, good "green" strength to resist cold flow, and the desired high modulus in the vulcanized product. Good pellet quality and fast incorporation are significant factors influencing all these properties.

FEF black is used in all kinds of polymers or rubbers including such special-purpose polymers as neoprene and nitrile rubbers, but applications are most numerous in rubbers which are difficult to process. This type of black is more beneficial in GR-S than in natural rubber.

FEF black is produced in this country by five manufacturers. It is produced also in Canada and England. Wet pelletized FEF black is being shipped in bulk to several tire factories.

The Use and Application of SAF Black in Various Rubber Hydrocarbons

J. W. Snyder[6]

IN AN era of power and speed it is only natural that the performance requirements of tires become more and more exacting. From the day of channel black as the sole reinforcing carbon, we have seen in a little more than 10 years a transition leading through high abrasion furnace black to the currently popular super abrasion furnace black.

The program of using the more reinforcing carbons has posed a combination of problems which as yet has not been solved. Of no mean consequence is the ability of present-day rubber dispersing equipment to make available the full potential of the finer particle size blacks. It is well recognized that dispersion difficulties mount as particle size decreases.

On the carbon production side we run into the "law of diminishing returns" in that at some point as particle size is decreased, cost becomes greater than the value of the corresponding gain in tread wear. Thus when we add together the

[6] Godfrey L. Cabot, Inc., Boston, Mass.
[7] Binney & Smith Co., New York.

limitations of processing equipment and the increasing carbon black costs, we are faced with a practical limit of particle size.

At the time the first experimental SAF blacks were made these limiting factors were not fully recognized, and little progress was made. True, superior road wear was demonstrated by these blacks. There were processing problems, however, and the indicated differential in cost above HAF black was not warranted on the basis of the degree of improved wear. For certain specialized uses these SAF blacks have found a market.

The need of improved abrasion carbons was apparent and the answer has been found in the present-day accepted volume of SAF blacks. While these commercial SAF blacks do not have the fineness of the aforementioned experimental type and do not show quite the abrasion resistance, they can be processed into rubber, do make possible super abrasion resistance, and are economically sound.

The fact that there are two ranges of abrasion resistance in the SAF black category has led some people to classify the experimental variety as SAF black and the generally accepted level as ISAF black or "intermediate" SAF black. There are others, including the speaker, who disagree with this terminology. The latter carbons, as proved by service tests, are super abrasion blacks and, therefore, warrant the designation SAF black.

With the advances in carbon production and rubber processing techniques we all have witnessed in recent years, it would be a defeatist's attitude to say that any black made to date is perfection. By introducing the term, ISAF black, it is assumed that SAF black would be that perfection. In the years to come there will be new blacks, and when these do find general acceptance, they can be named.

In the interest of clarity and so that there will be no misunderstanding we will forget personal feelings on nomenclature and say that the balance of this discussion will deal with the widely accepted SAF black range, otherwise known as ISAF black.

Since HAF black shows up to better advantage in GR-S than in natural rubber, it is only reasonable that SAF black should behave similarly. In GR-S the average abrasion resistance of SAF black is in the range of 120 to 125% of HAF black. The range of reported values is quite wide, from 110 to 140%. In natural rubber, SAF black averages 110 to 115% of HAF black, again with a wide range.

The behavior of SAF black as regards flex crack resistance is most interesting. In GR-S, where it shows up best in abrasion, the consensus is that there is no advantage over HAF black in flex crack resistance. Contrary-wise in natural rubber, which has not shown up the abrasion resistance to as great advantage, it is generally accepted that flex crack resistance is markedly improved. A part of this advantage may be accounted for in the lower loadings employed. So for one or the other of these reasons, SAF black rapidly is making a place for itself.

Those who want electrical conductivity find in SAF black a useful tool. By virtue of a combination of fine particle size and moderate structure SAF black is the best conductor aside from the more expensive acetylene black and conducting channel blacks.

Another application is in inside tire stocks. The maintenance of excellent hot properties along with modulus building qualities makes SAF black ideal for balancing the modulus and hardness of certain body compounds, to the higher modulus levels of SAF black treads.

As to compounding, SAF black requires very few, if any, changes when used in place of HAF black in GR-S. For the most part direct substitution is all that is needed. Some compounders, however, have felt that a small increase in softener is necessary, but not exceeding an additional two to three parts. Loadings are being maintained in the 45 to 50 PHR range.

Experience in natural rubber indicates best results when the SAF black loading is reduced as compared to HAF black. A range of 40 to 45 PHR is representative. Sulfur and accelerator are maintained at the same general level as they are for HAF black.

If SAF black replaces channel black, the same principle of about five parts lower loading applies. Here, as for HAF black, delayed-action accelerators are required and for processing safety anti-scorch agents, and/or retarding softeners. Sulfur dosage continues to be studied; the general average is somewhat lower than common with channel black.

The Use and Application of Channel Black in Various Rubber Hydrocarbons

L. R. Sperberg[*]

OF ALL the blacks available to the rubber technologist today, channel black is the oldest from point of service. For the past 40 years it has been *the* standard for comparison in every major development of reinforcing pigments throughout the world. To attempt to tell you how to employ a material that has been so universally used for such a long period of time seems almost ridiculous. I am sure that you members of the audience could tell the panel much more about the use and applications of channel black than they could tell you.

Until recently channel black has been the undisputed giant of the carbon black industry. Today it is forced to share its position of leadership with a new class of blacks just recently commercially exploited; I refer, of course, to the HAF type of black. Since HAF black was first introduced six years ago, the emphasis of development work has been placed upon this material for two reasons: (1) evident superiority in certain product applications; and (2) the declining production of channel black due to rising gas prices and to increased demand for gas for transcontinental pipe lines. Perhaps the rubber industry in its enthusiasm for new materials has been oversold on both of these points.

Because of the basic fear of the rubber industry that production of channel black would wither away in a relatively short time, many industrial rubber products that would normally employ channel black in their manufacture have been recompounded to use the new reinforcing oil black pigments at higher costs. These costs are both actual and indirect; and by indirect cost, I refer to the problem of scorched stock.

At this point, let us view briefly several product applications that are "naturals" for channel black usage.

First of all, let's look at natural rubber. At today's low prices, natural rubber is being used in ever-increasing quantities; the prime motive is to lower compounding costs. In addition, with the specter of a highly competitive market looming in the future, the drive is on to lower manufacturing costs. This all adds up to one thing: A manufacturing tempo that spells out *Speed* with increased trouble for production men as well as technical men. This means shorter and shorter Banbury mixing cycles, higher processing temperatures, and, of course, *more* wasted stock due to premature vulcanization. To alleviate this problem, safer processing stocks *must* be developed. Channel black stocks are safer processing, and the use of channel black will go a long way toward reducing that real, but also intangible cost of "burnt" stock.

Another truly natural application for channel black is in truck tire treads. And yet in recent months channel black has been losing ground to the reinforcing oil blacks because of the cracking problem. I simply ask this question: Is it not possible, yet even probable, that an amount of work done on channel black, equal to the evaluation and development work expended on reinforcing oil blacks, would have resulted in comparable quality stocks at cheaper overall costs? I think it would.

The reinforcing oil blacks have shown only moderate improvement in abrasion resistance with increased manufacturing and material costs. The problem of cracking in natural rubber channel black truck treads is, very likely, one of curative level rather than of type of black. Today most natural rubber truck tread formulations are much the same as they were 10 to 15 years ago, despite the fact that speeds and loads on these tires are much greater than they were a decade ago. Natural rubber channel black stocks have, in general, been compounded with excessive curative. There are recent data supporting the contention that a reduction in curative level to a point comparable to that used with reinforcing furnace blacks may solve the problem of cracking in truck tires without aggravating the heat build-up problem.

A third "natural" application for channel black in *any* rubber is in those products where high tensile strength is important in meeting purchasing specifications. Regardless of what type of elastomer is used, no other reinforcing carbon pigment will equal channel black in imparting high tensile strengths and elongations. This point is of prime importance in the mechanical rubber goods field.

Still another "natural" application for channel black is in Butyl rubber. I am sure you have all heard the rumors floating around about the exceptional performance of Butyl rubber in *tires*. And which black imparts a maximum of reinforcement to Butyl rubber? The answer: channel black, of course. It is interesting to speculate on why channel black will reinforce Butyl rubber to higher potential

[*]Sid Richardson Carbon Co., Fort Worth, Tex.

levels than reinforcing furnace blacks, and to wonder what might happen if we were to discover the secret and apply it to other-type elastomers.

And now I should like to ask you a question. Why should you, the rubber technologist, spend any time doing development work on a product that has been slated (by many) for replacement by more recently developed blacks? The channel black industry isn't dead; it's not even dying. It is still really a giant in its field, hardened and toughened as a result of its competition with the reinforcing furnace blacks. To be sure, certain high-cost plants have been shut down, and a few more still remain to be shut down, but that is the price of progress. But even when all of these high-cost plants have ceased operation, the channel black industry will still produce about 400,000,000 pounds of black annually—an amount that is roughly equivalent to the total current production of FT, HMF, FEF, and SAF type blacks. An impersonal analysis of new gas fields being drilled, long-term gas price trends, etc., all point to the conclusion that this amount of channel black will continue to be produced annually for many years to come; and in all probability an increase in this production figure can be anticipated.

In the difficult economic day ahead, channel black stands ready to help you solve your problem of cost and quality as you work to stay competitive.

Questions and Answers

Q. Do the ISAF blacks give equal improvements in tread wear in cold rubber, natural rubber, and oil-extended GR-S?

A. Amon. Tread wear improvement by ISAF black appears to be essentially equal for cold rubber and natural rubber, but in oil-extended GR-S the improvement is less.

Q. Thermal black has been suggested as a black suitable for tire carcass compounding. Why do you think its usage in this application has been very limited?

A. Maassen. Laboratory test data and preliminary testing indicate that thermal blacks can be substituted in part or wholly for SRF black in tire carcass compounds. At one time it was proposed to use thermal blacks for this purpose, but it was found that there might be difficulty in supplying thermal blacks in the required amounts. Since then, however, a second supplier has entered the field so that it might again be worth while to investigate the possibility of thermal blacks for this application.

Q. To what extent do you estimate that the tire industry has converted from channel black to HAF black in tread compounds?

A. Studebaker. This year the world use of HAF blacks is almost identical with the use of channel black. However 88% of the HAF black is consumed in the United States, almost exclusively in tires. Only 59% of the channel black is consumed in this country; the remainder is exported. The non-rubber color market takes a healthy bite out of this domestic consumption of channel black and leaves only about half the production for all rubber uses. This is distributed between non-tire uses, carcasses and natural rubber truck and bus treads. My personal estimate is that over three pounds of HAF black are used in tires in the U.S.A. for each pound of channel black. Almost all first-line synthetic rubber tire treads are compounded with HAF black. In addition, most manufacturers of natural rubber truck and bus tires have converted from channel black to HAF in treads. There are still some exceptions, however.

Q. Which blacks can be successfully handled in bulk at the present time? Can bulk handling facilities installed for channel black be utilized for bulk handling of furnace blacks?

A. Drogin. All rubber grades, with the exception of the thermal MT and FT black types, can be successfully handled in bulk. There is a preference for wet pelleted SRF, HMF, and FF black types, and for dry pelleted HAF and SAF black types, when shipped in bulk. Both dry and wet pelleted channel black are preferred equally for bulk shipments.

Regarding FEF (MAF) black, the shipping of this type of black in bulk presents a problem at times. All producers will admit there is room for much improvement. They are therefore endeavoring to do so either by a dry or wet pelleting process or by a combination thereof. We feel that within a short time the whole industry will have an FEF black suitable for bulk shipment.

The bulk handling facilities installed for channel black are currently being used for bulk handling of furnace black. It should be noted, however, that such practice is not generally the most efficient inasmuch as the handling requires careful watching in order to prevent choke-ups. The unloading rate must be reduced, prolonging the unloading time of a shipment. The amount of fines are increased owing to a greater breakdown of the pellets; and where a screw lift system is used, it is advisable to handle the black in a series of lift stages. Generally speaking, furnace blacks are more troublesome to handle in an air lift system than channel.

Q. What are the prospects that oil furnace blacks will be expanded in the direction of soft gas blacks as they have been in the direction of SAF blacks?

A. Amon. Oil furnace blacks have been extended in the direction of soft gas furnace black, and two brands have been announced as GPF (general-purpose furnace) blacks.

Q. To what extent is the usage of oil furnace blacks dependent on the use of GR-S?

A. Snyder. While the improved road wear obtainable with SAF black is most apparent in GR-S, the use of this type of black is not limited to that field. The almost universal observation that SAF black improves flex cracking of natural rubber stocks has led to a wide and increasing use. Little work has been done in other polymers since, for the most part, maximum abrasion resistance does not enter into consideration.

Q. Can use of the high priced SAF-ISAF blacks be justified in the highly competitive year ahead of us?

A. Studebaker. Competition is not limited to manufacturing cost. It can also apply to quality. Here the SAF and ISAF blacks have a place. Where greatest resistance to abrasion is sought in premium-grade passenger tires, and where maximum resistance to flex cracking and cut growth is sought in large truck and bus tire treads, and in special, high-quality items, the compounder should surely give SAF and ISAF blacks serious consideration. Furthermore the cost-conscious compounder should study higher loadings of these blacks in oil-enriched polymers as well as combinations of these blacks with cheaper blacks at different softener and total carbon black loadings. I personally expect to see wider use of these especially high abrasion blacks in the coming year. Competition in the quality market will foster their acceptance.

A. Sperberg. In my opinion it is doubtful if the additional cost of the ISAF or SAF type blacks can be justified by the improvement in tread wear resistance in a highly competitive market. I. J. Sjothun and co-authors[9] have shown recently that ISAF blacks are roughly 6% superior to HAF blacks, which in turn are approximately 11% superior to EPC blacks. The 11% improvement with HAF black can be obtained at only a half cent per pound increase; whereas the additional 6% improvement for ISAF blacks costs 3.1¢ per pound additional. If MPC black is used instead of EPC black, the cost picture is even darker since MPC black is roughly 6% superior to EPC black in abrasion resistance.

[9] *Rubber Age* (N. Y.), 74, 231 (1953).

Q. What effects do non-stain specifications have on manufacture and properties of carbon blacks? With the non-staining property of black becoming of increasing importance, is there the chance that NS blacks will be premium priced? If so, why?

A. Carlton. Before these questions can be answered the term "non-staining" must be defined. Distinction must be made between the staining of enameled surfaces in contact with a rubber compound containing carbon black and between the bleeding of materials through and subsequent light discoloration of the white sidewalls of tires.

To be non-staining to enamels a black must have a substantially colorless benzene or chloroform extract; whereas some color in the benzene extract can be tolerated in the blacks that are used in the carcass compounds of white sidewall tires.

In general it is more costly to produce either non-staining or non-bleeding blacks; the cost increase depends on the specification that must be met. One type of non-staining black now carries a 1¢ per pound premium.

The properties of non-staining blacks in rubber are substantially unchanged from their staining counterpart.

Q. As the price of natural rubber fluctuates above and below that of synthetic rubber, what effect does this have on the usage pattern of carbon blacks in the tire industry and in the mechanical goods indutry? On what blacks does this fluctuation seem to have the greatest effect?

A. Snyder. As economics bring about increased use of natural rubber, the normal pattern a short while ago would have been a swing from oil furnace blacks in tire treads to channel black. With the advent of SAF black it looks as though this pattern is being changed. With SAF black performing well both in GR-S and natural rubber the change will be more in the direction of loading than in type of black.

In the case of mechanical goods there might be some change in the carbon black usage pattern. The blacks which have a beneficial effect on extrusion properties of GR-S have a similar, although not so striking effect in natural rubber. Depending on the exact extrusion gage requirements some would use the same blacks;

while others would change to lower-cost SRF black. The carbons used as fillers and general processing aids in molded goods are needed for both types of polymers.

A. Sperberg. In general as the price of natural rubber falls below that of synthetic rubber, both the tire and mechanical goods industries switch to natural rubber for material cost savings. With this switch the demand for channel black is accented while the demand for the HAF and ISAF type of black decreases. This is readily seen in the Bureau of Mines statistics on carbon black. During the past year the rubber industry has increased its take of natural rubber, with a subsequent strengthening of demand for channel black and a decline in demand for the reinforcing furnace blacks.

Q. Are there any physical or chemical properties of carbon blacks that affect cracking of natural rubber or GR-S?

A. Carlton. In general, cracking increases with decreases in particle size when comparisons are made at equal loading. Chemical properties of carbon blacks have little, if any, connection with cracking.

Q. Does the oil absorption of a black have any effect on tire tread cracking, assuming that proper compound procedures have been followed?

A. Carlton. Only in so far as the oil absorption lines up with particle size.

Q. Can surface area of a black be used as a true guide for compounding for abrasion resistance in tires (tread stocks)? Or, are other factors such as structure just as important?

A. Studebaker. Surface area does not correlate with road wear except in a very general way. Other factors are unquestionably important. My personal opinion is that the road wear is determined by particle size, hydrogen content, and oxygen content of the carbon black, but each of us has his own opinion on the matter. The question is far from settled.

Q. Have any of the carbon blacks developed by the Germans proved to have qualities superior to those manufactured under U.S. companies' patents?

A. Carver. I take it that this question refers to the two well-known German blacks: namely, CK-3 and CK-4. These blacks are not superior to those manufactured under U.S. companies' patents, although in service German blacks are known to be of good quality, giving satisfactory tread wear on European roads.

Q. Are there any data available on solving the flex cracking problem of natural rubber-channel black treads? Cracking and cut growth are two of the major problems in truck tire treads. From the usage of carbon black, what is the best compounding approach to this problem in both synthetic and natural rubber truck tire treads?

A. Snyder. The best solution to flex cracking of natural rubber-channel black treads is to substitute SAF for the channel black, which requires certain compounding changes, however. Truck treads, particularly the larger sizes where cracking might be a problem, are not very commonly made with GR-S. However, general experience would indicate HAF as best in GR-S at lower loadings than employed in passenger treads.

A. Sperberg. Undoubtedly the greatest single compounding factor which influences cracking in tire treads lies in the curative levels employed. In my opinion natural rubber-channel black treads are invariably overaccelerated and are holdovers from truck tire tread development work that was done in the late 1930's. Emphasis during the '40's and to date has been on synthetic rubber, and quite understandably very little work has been done on natural rubber formulations. Laboratory data show quite conclusively that both sulfur and accelerator dosages can be lowered materially with tremendous improvement in crack growth resistance with negligible increase in hysteresis. Truck tire tests as well as passenger tests have verified the laboratory findings.

The type of carbon black employed in tread stocks has only a small effect upon crack growth resistance if the formulation is properly accelerated.

Q. What is the future position of the various carbon blacks in supplying the rubber industry?

A. Drogin. The carbon black industry is in a good position to meet the demands of the rubber industry for the quality of carbon blacks on which they are currently standardized. In reviewing the picture for the past year we find that with reference to channel black, production and shipments last year were almost exactly in balance. In other words, the production amounted to 454,263,000 pounds, and shipments reached 454,843,000 pounds. The inventories of channel black on December 31, 1953, amounted to 234,000,000 pounds, or a little better than six months' supply. From 1950-1953, channel black shipments declined 32%.

With reference to furnace black, inventories increased approximately 40 million pounds during 1953, which would indicate an excess capacity over current requirements. Inventories on December 31, 1953, amounted to a little less than two months' shipments. However, as the industry has surplus capacity, this stock position is not out of balance. Furnace black manufacture has been curtailed. It should be remembered, however, that curtailment of a furnace plant is not so detrimental to its subsequent operations as is the case with a channel plant. For once the latter is shut down, considerable deterioration results immediately, to say nothing of the loss of raw material supply.

Q. Tremendous developments in furnace blaeks have taken place in the past 10 years. Are any comparable developments foreseen for channel blacks?

A. Sperberg. It is probable that major developments in the channel production of new types of reinforcing carbon black can be anticipated. The major cost of carbon black manufacture is directly attributable to the cost of the basic conversion stock, whether oil or gas. It is as unreasonable to assume that gas costs will continue to increase rapidly and oil conversion stock will remain constant while crude oil costs are increasing. The picture is very favorable for the production of fast-curing highly reinforcing blacks produced by the channel process. It is probable that these blacks can be produced and sold at lower costs than for comparable oil blacks.

Q. What are the advantages, if any, of oil-treated blacks, and where are they being used?

A. Snyder. Oil-treated blacks are useful only where the very minimum of dust can be tolerated in a plant. There has not been demonstrated any quality advantage. In some cases oil-treated blacks have been used to improve bulk handling qualities. The largest use of this type has been in the reclaim industry where keeping loose black down to a minimum is a must.

Q. How and why are blends of the various blacks used in many stocks? What are, if any, the economic and technical advantages of using blends of black? Does the blending of two blacks give intermediate performance in line with the proportions of the blended blacks?

A. Drogin. There are various reasons for using blends of blacks. One is to lower the compound cost; another is to improve the physicals of the uncured stock; a third is to obtain the maximum benefits of the combined properties of the blacks without impairing service performance; a fourth is to reduce the amount of noise in a tread stock; and a fifth is to avoid carrying an additional type of black and utilizing the blacks which are regularly carried in the mill room to obtain the same properties that would be derived from a proposed black.

As to how blends of blacks are generally used, the blacks involved are usually added to the mix successively, the harder mixing and finer particle size black advisably added first, provided it does not constitute the major portion of the blend. The main thing to bear in mind is to have the black incorporated within the specified mixing cycle time.

The performance obtained from a blend of two blacks is governed primarily by the proportions of each black used.

Q. To what extent have the new furnace blacks replaced channel black?

A. Studebaker. I shall confine my answer to domestic consumption of carbon black by rubber companies. If the questioner means oil blacks, then virtually all the HAF, SAF, and ISAF blacks plus about half of the FEF blacks have replaced channel black from uses which it would have if there were no oil blacks or similar blacks and if channel black were readily available at a competitive price. The quantity involved is believed to be between 2¼ and 2½ pounds of oil-type furnace black for each pound of channel black used in rubber.

Q. When will channel black production stop entirely?

A. Studebaker. In my opinion channel black will be continued to be produced for a number of years. It has a definite place in the color market. However, its use in rubber will decline. Ten years from now, channel black will probably be used in some rubber products, but I feel that channel black consumption in rubber will then be greatly reduced.

A. Sperberg. My answer to the question on the future of channel black would be that there should be continuing channel black production as long as there is a demand for its products. We think that channel will always be available to the rubber industry.

Q. What are some of the compounding techniques employed to improve resistance to scorch of furnace black compounds?

A. Amon. Resistance to scorch is being improved by use of delayed-action type of accelerators and by use of retarders. Use of acidic-type softeners, rubber peptizers, and mechanically plasticized rubbers is helpful.

Q. I want to make a good conducting compound that will retain its conductivity in use. What type of black should I use for best results?

A. Carver. It has generally been recognized throughout the rubber industry that acetylene black gives the best conductivity. However, acetylene black, when compounded into rubber loses a considerable amount of its conductivity if the rubber article is subject to flexing in use. The recent introduction by the carbon black industry of super abrasion furnace (SAF) blacks has drawn to the attention of rubber compounders the fine conductivity of this new type of black which, unlike acetylene black, does not lose much of its

conductivity when the rubber product is flexed. The care taken in the processing of the rubber product requiring good conductivity, especially to avoid overmilling and reworking of uncured scrap, is most important. A minimum loading of 50 parts of black is recommended. Further, conductivity increases greatly with the increase in the carbon black content.

Q. There are two basic processes for the manufacture of carbon black beads. What are the advantages and disadvantages of the wet bead? Of the dry bead? Are some types of black more difficult to bead than others? Why?

A. Drogin. The *advantages* of *wet* pelleted or bead black are firmer, denser pellets which are more readily adapted for shipment in bulk and bulk handling. The pellets break down less in transit, and they contain fewer fines. The fact that the pellets are subjected to a drying step which involves a relatively high temperature helps, in some cases, to make the black less staining. Another advantage in wet pelleting a black is the maintenance of a more uniform bulk density.

As to the *disadvantages* of *wet* pelleted black, the process is more expensive, and there are more variables to contend with involving the amount of water, dryer temperatures, and time; it is recognized that in the case of the oil-base furnace blacks ISAF, HAF, and FEF (MAF), the wetting and the attendant drying of the pellets to expel moisture will result in a somewhat harder pellet which if not completely dispersed in the rubber, will reflect in a lower modulus and slower rate of cure. To offset this condition, the quality level of the oilbase black which is to be wet pelleted must be sufficiently high so that the final product, despite the degrading effect of the wetting and drying, is comparable in every respect with the same type of black that is dry pelleted.

The *advantages* of *dry* pelleted or beaded black are that the process itself is simple and it involves no drying step. The pellets are softer and therefore lend themselves to more ready dispersion. The bulk density of dry pelleted black can readily be varied.

The *disadvantages* of *dry* pelleted or beaded black are that in the case of thermal FT and MT types, and the gas-base furnace blacks, SRF and HMF types, the dry pelleted process does not produce a pellet so readily suitable for shipment in bulk as the wet pellet. There is a greater tendency for degradation in transit of the dry pelleted black that is shipped in bulk; dry pelleted black generally contains a higher percentage of fines. More care must be devoted to the dry pelleting of oil-base blacks to maintain a uniform bulk density.

Some types of black are more difficult to pellet than others. This is particularly so when the black is dry pelleted. Channel black made from high BTU natural gas does not dry pellet so readily as when made from much leaner gas. There is a difference in the dry pelleting of SRF and HMF blacks and in the dry pelleting of the oil-base blacks, FEF (MAF), HAF, and ISAF types. The reasons for the difference in pelleting are, according to an unpublished paper by Mr. Studebaker, attributable to the forces of attraction that exist among individual particles of colloidal dimensions. These forces are known as "long-range London-van der Waals forces." The types of carbon black considered to have strong attraction among the individual carbon particles are those which are the most difficult to convert into dense pellets. The loose black is picked up very readily by the pellets in the pellet mill, but the soft "cake" which it forms on the outside of the pellet is very difficult to densify. An enormous amount of work is necessary to compact it, and this work must be performed in such a manner as to avoid crushing the pellets. This requirement creates quite a problem for carbon black manufacturers. In the wet process the amount of water added to a given amount of carbon black is carefully controlled in order to form the pellets. Water requirements for wet process pelleting are determined almost exclusively by particle to particle attraction of the carbon black.

Q. Where have the new "hydrophilic blacks" found greatest value in the rubber industry?

A. Studebaker. Hydrophilic means a high affinity for water. We know of no new hydrophilic blacks which are being used by the rubber industry. The most hydrophilic black which is used in any real volume is channel black. Experimental furnace blacks have been produced which contain considerable quantities of oxygen, and these are more hydrophilic than other furnace blacks, but as far as we know, their production and use are purely experimental.

Q. When is a white carbon black going to be economically available?

A. Amon. The term carbon black includes all types from medium thermal to super abrasion furnace, but the term "white carbon black" is customarily used to mean a white pigment equal to rubber grade channel black in reinforcement. Fine particle silica is commercially available, but at prohibitive prices, which comes at least close to meeting this classification. Economically available white carbon black appears to be at least years away.

Q. What factors (raw materials, process, carbon black physical and chemical properties, etc.) associated with carbon blacks and their production influence the hystereis properties of elastomeric compounds?

A. Snyder. The two factors which have the greatest effect on hysteresis are particle size and structure characteristics of the carbon black. The finer the black the greater the hysteresis. Structure, as it affects modulus, has an effect dependent on the method employed to measure hysteresis. If heat generation is the hysteresis measure, it will be found that with particle size being held constant, higher modulus will decrease hysteresis when the test is carried out under conditions of constant load and will increase hysteresis if tested under constant deflection. If the load is constant, higher modulus means less deflection or less motion in the stock. Constant deflection requires a greater load to be applied to a higher modulus stock to obtain a given deflection. This means that the cycles will be carried out under greater load, and heat generation will be greater. Thus, what any one particular machine will show will depend on the balance of the two conditions. When hysteresis is measured by rebound, higher structure tends to decrease rebound or, in other words, raises hysteresis. In the case of torsional hysteresis, structure shows a slight tendency to decrease hysteresis. All in all, hysteresis must be measured and judged on the basis of the type of service to which the rubber will be subjected.

Q. How much are the various grades of carbon black dependent on natural gas?

A. Maassen. The types of carbon black dependent on natural gas are thermal blacks, the gas furnace blacks, and the channel blacks. Oil enrichment of natural gas can be employed with several types, but the types mentioned are largely dependent on natural gas.

Q. What is the relationship between temperature of the flame and particle size of carbon black?

A. Carver. The answer to this question would be that, allowing for other production conditions, the hotter the flame the smaller the particle size.

Q. Which types of black cannot be shipped in bulk, i.e., give too soft pellets?

A. Drogin. Actually, the thermal blacks, FT and MT types, are currently the only blacks unsuitable for bulk shipment. They give too soft a pellet by the dry process. To wet pellet the black in order to produce a harder pellet may result in a product that will not impart the same rubber properties as the unpelleted black.

As a matter of fact, every type of black can be shipped in bulk provided its pellets are sufficiently dense and firm to withstand handling and transportation and yet be easily and completely dispersible.

Q. What are the limits on water content of carbon blacks arriving in Akron?

A. Carlton. This depends on type of black, method of shipment, and weather condtions. Moisture content of black in bags may reach 1% for SRF and HMF, 2.5% of FEF and HAF, and 3.5% for channel and SAF. Hopper-car shipments may reach 2% for channel, HAF, and SAF, and 1-1.5% for other types. Moisture content at time of packaging is under 1% for all blacks.

Q. What are the tests for determining uniformity and classification?

A. Carver. Carbon blacks are tested by the producers according to their own individual methods for governing the quality of their products. These tests, however, may be summarized as physical, chemical, and rubber tests run on definite plant control procedures—determination for the percentage of residue in the carbon black and percentage of fines among the pellets. Where particular characteristics of black are of importance to meet a special customers' requirement, such as staining, then the black supplier supplements his routine tests with a specific determination to meet the quality required.

Q. Are there any proofs that improved dispersion gives better properties in elastomers?

A. Maassen. Dispersions better than those commonly obtained in practice do *not* give better wear, but may give better resistance to cracking and tread growth. Better dispersion can give better properties in Butyl inner tubes where undispersed aggregates may cause service failure.

Q. Of all of the various classificaitons of black, SRF seems to be the grade of which each carbon black manufacturer has at least three types. What are they, and why?

A. Amon. Three common types of SRF black are the soft low modulus type, the high modulus type, and the non-stain type. These are manufactured to meet specific customer requirements. The soft type has advantages in high loading capacity; the high modulus type is used for reinforcement, particularly in combination with the more reinforcing blacks; and the non-stain type is used for obvious reasons in many rubber products.

Q. What effect, if any, does shaping or roller pressing of bags of black have on the processing properties of the black? If there is an effect, are some grades affected more than others?

A. Drogin. Roller pressing, shaping, and the so-called "tailored" bag and the valve-type bag, all of which also utilize the roller pressing principle, will not affect the processing properties of the black provided the shaping or roller pressing process does not excessively reduce the volume of the black. Experience has shown that bags of pelleted channel, SRF, and

HMF blacks can be reduced as much as 25% in volume without affecting their processing properties. Oil-base blacks FEF (MAF), HAF, and ISAF are somewhat more sensitive to reduction in volume; their bags should be lightly roller pressed or shaped; otherwise it will be harder to effect good dispersion.

It has been noted that overshaping or excessive roller pressing of, for instance, SRF black results in a breakdown of the pellets; consequently, this finer density black is a little more troublesome to incorporate and tends to process hotter. But these disadvantages are compensated for by the economic advantages with regard to handling, storage, and freight, particularly in the export market.

I might add that in the average of export shipments, about 16% has been bag flattened channel black, and slightly less than 5% bag flattened furnace black. In our company a little over 65% of the domestic shipments of *bag* black last month was roller pressed.

Q. What effect, if any, does pellet quality have on speed and ease of mixing or on the physical test performance of finished products?

A. Studebaker. Good pellets are incorporated into rubber more readily than poor pellets. In fact, experiments have shown that the rate of incorporation depends very markedly upon pellet quality. The more the pellet quality is improved, however, the more difficult it is to obtain optimum physical properties of the finished product. This difficulty is believed due to increased difficulty in completely dispersing the pelleted black. The modulus and abrasion resistance are definitely reduced, and other properties are also affected to a lesser degree. In fact it is quite likely that almost every rubber property is affected, but to different degrees. The carbon black producers must do an enormous amount of work on pellets to compact them. The more work done on the black during pelleting the more difficult the pellets are to disperse completely in rubber.

Q. In view of the trend toward higher and higher abrasion resistant tires, what will be the "leveling-off" point?

A. Snyder. As pointed out earlier, we expect to see new carbons in the future. Just what the "leveling-off" point on abrasion resistance will be is still too far in the future for us to see at this time. A lot depends on processing equipment changes, new accelerators, anti-scorch agents, etc. Also of prime importance will be, "How far will tire manufacturers want to go!"

Q. How can the carbon black suppliers contribute to greater safety, rather than greater wear, in a tire?

A. Studebaker. This is a question that can best be answered by the rubber companies. It might be mentioned, however, that the European market is quite safety conscious. And in some places the SAF blacks are being seriously considered for high-speed tires.

Q. What are the relative tread wear ratings of MPC, HAF, and ISAF blacks in the three main types of polymer—cold GR-S, oil-extended GR-S, and natural rubber?

A. Amon. Ratings obtained in cold GR-S and natural rubber are approximately 100, 115, and 135, respectively. In oil-extended GR-S blends, ISAF black has rated 10% better than HAF black. Ratings vary depending on the severity of road test conditions, but these ratings are based on average road test conditions. Ratings of ISAF black in % of HAF black for natural rubber treads have varied from 110 to 140, increasing with severity of service. All ratings are based on passenger-tire tests.

Q. What would be the normal range in particle size and surface area of the ISAF and SAF grades of carbon black? Would these variations influence the properties of the vulcanizates, and if so, which properties would be influenced?

A. Snyder. The particle size of what is referred to as ISAF black is in the range of 22 millimicrons with a surface area of 14 acres per pound.

For SAF black the values are 19 millimicrons diameter and surface areas of 16 acres per pound.

Vulcanizates show higher tensile, greater hysteresis, and somewhat elevated hardness for the SAF black.

Q. Does the modulus development of vulcanizates have any effect on their reinforcement and road wear, or is the modulus development simply an indication of the cure rate which can be regulated by curatives?

A. Studebaker. The modulus of rubber is an indicator of physical properties, but in itself it is a poor criterion of either reinforcement or expected road wear. High modulus stocks can be made in many ways, for instance, with diatomaceous earth, but such stocks can hardly be considered to be highly reinforced.

A. Sperberg. Very little information is available on the effect of tire stability on road wear, but, in general, the more flexible the tire the faster will be its rate of wear. Modulus, then, will affect road wear only with respect to its ability to alter tire flexibility.

Q. What is the best way to express the reinforcing ability of carbon black? What measurable characteristics of blacks are most indicative of reinforcing quality?

A. Studebaker. Reinforcement means different things to different people. A general definition would be:

"Reinforcement is the enhancement of one or more properties of an elastomer by the incorporation of some ingredient which makes it more suitable for a given use."

Because of its tremendous economic importance, resistance to tread wear has frequently been associated with reinforcement. However, to a mechanical goods compounder this would be an unsatisfactory measure of reinforcement. I rather like the English attitude that reinforcement is associated with tensile strength, abrasion resistance, and resistance to tear. Unless a filler enhances *all* of these properties, it is not considered a true reinforcing agent. Fundamental physical properties on the carbon black which can be taken as indicators of reinforcement are: (1) particle size, (2) surface area, (3) hydrogen content, (4) oxygen content, which seems to affect reinforcement adversely in most cases, and (5) the property which we refer to as "structure." Highest reinforcement, however we define it, depends on a balance of these fundamental properties. The final answer is based on use tests of the finished product.

A. Sperberg. Rightly or wrongly, most rubber technologists associate reinforcement potential with ability to withstand abrasive action. Thus, to a tire man the reinforcing ability of a particular carbon black is measured by the number of miles a tire will go before it is worn out.

A mechanical rubber goods man, on the other hand, is much more interested in tensile strength because so many of his products must meet a tensile specification. Hence, to him, reinforcing ability is going to be measured by the ability of the black to impart certain tensile properties.

Q. Are HAF blacks more quickly incorporated in GR-S than EPC blacks? If so, why? Is this also true with natural rubber?

A. Amon. HAF black incorporates faster than channel black in GR-S and in natural rubber. This general experience cannot be due to pellet quality since the pellet stability of channel black is typically better. Pellet quality, however, does have a great influence on rate of incorporation.

Q. What is being done to develop a black particularly suitable for reinforcement of Butyl rubber. What commercial black is most suitable for Butyl?

A. Carlton. In answer to the first part of this question I can speak only for our own organization. I assume the question pertains to tire compounds rather than to inner tube compounds. All known commercial blacks have been evaluated, and channel black has been found to be best. All research blacks are evaluated as they are produced.

Q. What work, if any, is being done to enhance the reinforcing quality of carbon black? Are the SAF blacks the final word in abrasion resistant blacks, or do you foresee blacks of even greater reinforcement quality?

A. Sperberg. The carbon black industry has striven constantly over the years to produce more reinforcing blacks just as the tire companies have worked to develop better and better tires. This development work will continue in both industries. The speaker foresees blacks of even greater reinforcement potential than the best present reinforcing blacks.

A. Snyder. This question in effect has been answered. The carbon companies continue their research programs in the direction of more reinforcing blacks, and the final word has not been written.

Q. Are there any recent developments in pelletizing blacks or other means of reducing the dusting involved in mixing black and rubber?

A. Amon. There are two recent developments. One is the oil treated furnace blacks, and the other is an improved wet pelletizing process. Pressing and shaping of bag black is a step in the opposite direction, resulting in more dust in the carbon black, more dusting in the mixing operation, and frequently a decrease in the rate of incorporation of the carbon black in rubber.

Synthetic Rubbers Discussed

TALKS by Norman R. Legge, Kentucky Synthetic Rubber Corp., and Fred C. Wagner, E. I. du Pont de Nemours & Co., Inc., featured the March 25 dinner-meeting of the Southern Ohio Rubber Group, held at the Engineers Club, Dayton, with 100 members and guests attending.

Speaking on "Synthetic Elastomers in the Louisville Area," Dr. Legge gave a description of the various operations in the manufacture of GR-S; he used flow charts.

Dr. Wagner showed films of Du Pont's neoprene manufacturing plant in Louisville, and described arrangements for plant tours during the Rubber Division's meeting there.

In a brief business session preceding the talks, Stewart L. Brams, Dayton Chemical Product Laboratories, Inc., and Group chairman, reported on his visits to various rubber groups representing the Division vice chairman, John M. Ball, Midwest Rubber Reclaiming Co. K. C. Tregillus, Vernay Laboratories, acted as meeting chairman and introduced the speakers.

N. Y. Group Program on New Synthetic Rubbers

THE spring meeting of the New York Rubber Group held in the Henry Hudson Hotel, New York, N. Y., April 2, was featured by an afternoon technical program on new synthetic rubbers and an after-dinner program on rocket power. At the afternoon program the first speaker was R. P. Dinsmore, vice president, Goodyear Tire & Rubber Co., who discussed "Polyester Rubbers," and the second speaker was A. M. Borders, associate director, research department, Minnesota Mining & Mfg. Co.

The after-dinner speakers were Louis R. Rapp, chief chemist, and W. C. Kimm, public relations, Reaction Motors, Inc.

About 325 members and guests of the Group attended this meeting, which was presided over by Joseph Breckley, Titanium Pigment Corp., chairman of the New York Group.

Dr. Dinsmore in his talk first discussed polyester rubbers in general and then gave some details of the work being done by Goodyear on its polyester-isocyanate rubber, Chemigum SL. A good part of the information was similar to that presented before the Washington Rubber Group in March, 1953.[1] Interesting and useful films (unsupported or as adherent paint-type coatings) can be prepared from the liquid Chemigum SL in thicknesses up to eight or ten mils in one application. They possess a high degree of abrasion and mar resistance as demonstrated when used as golf ball lacquers.

Foamed sponge products called Airfoam SL result from a process radically different from that employed in making latex foams and provide a product with many advantages, it was said. For example, a high quality, uniform-pore structure polyester-isocyanate rubber foam at 3 lbs./ft.^{3} density is the equivalent of a 6½-lb. natural rubber latex foam. The normally unicellular polyester foam may be ruptured to give interconnected pores by forceful compression of the closed cells resulting in a pleasing "feel." Many new and as yet unforeseen applications can be developed for this new foam because of its exceptional fire, oil, and grease resistant qualities.

The combination of unique properties of Chemigum SL permits the prediction of a favorable future for this type of rubber even though it is rather expensive at the present time, Dr. Dinsmore said. Cost prospects are indeterminate because of the uncertainty as to the future cost of one or more of the desirable diisocyanates. At $4 a pound for the diisocyanate the cured rubber would cost $1.06 a pound; at $1 for the diisocyanate, the cured rubber would cost 61¢ a pound. These estimates are based on a cost for the polyester of approximately 38¢ a pound.

Dr. Borders explained that the work at 3M was a cooperative research program sponsored by the Wright Air Development Center of the U. S. Air Force, the object of which has been the development of fluorine-containing rubbers with exceptional resistance to fluids and lubricants. Particular emphasis has been placed upon resistance to synthetic diester lubricants at elevated temperatures.

The class of fluorine-containing rubbers which has been most completely explored is polymers of 1,1-dihydroperfluoroalkyl acrylates. Rubbery products have been obtained with ethyl to hexyl alcohols. Octyl and decyl derivatives are resinous.

Poly-FBA, or 1,1-dihydroperfluorobutyl acrylate, when properly compounded and vulcanized, provides low swelling in aliphatic and aromatic solvents and oils; excellent serviceability in synthetic lubricants, hydraulic fluids, and other high boiling liquids at temperatures up to 400° F.; and good resistance to oxidation, by air, pure oxygen, ozone, or fuming nitric acid. The use of this rubber in products such as O-rings, gaskets, packings, valves, diaphragms, hose, belting, can and tank linings, and roll coverings should merit investigation. Although it has definite low-temperature limitations, Poly-FBA is the most resistant to hot diester lubricants of any synthetic rubbers tested.

Dr. Borders emphasized that continued research and development are essential if rubbers serviceable above 500° F. are to be realized.

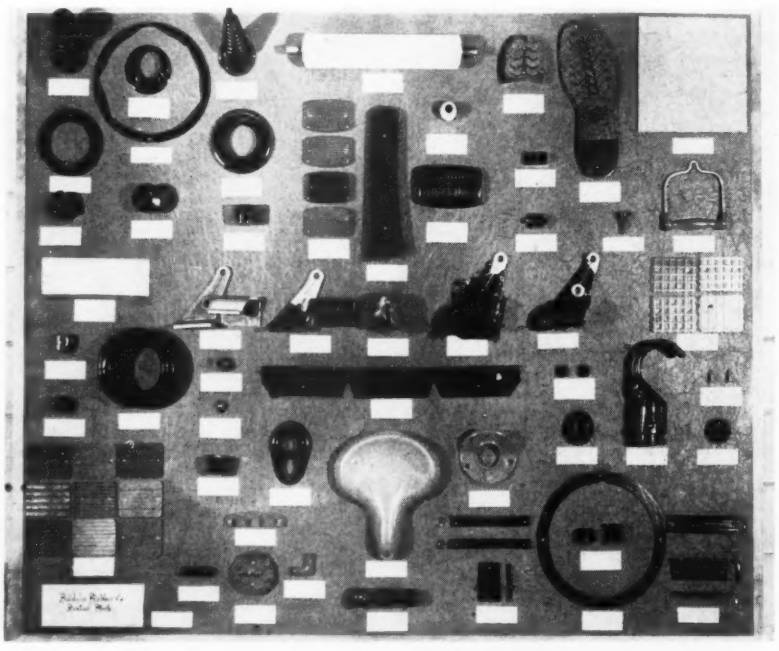
In their after-dinner talks Dr. Rapp and Mr. Kimm explained the theory and practice of rocket propellants, with special reference to the rocket motors made by their company. Sound films including one on the Navy Viking rocket concluded the program.

[1] See our May, 1953, issue, p. 222.

Baldwin Rubber-Wayne University Display Board

THE accompanying photograph shows a display board prepared by employes of Baldwin Rubber Co., Pontiac, Mich., for use in connection with the course in rubber technology sponsored by the Detroit Rubber & Plastics Group at Wayne University. The board illustrates the wide selection of rubber goods parts made in a typical mechanical goods plant.

A feature of the display is shown in the middle section in the important steps taken in the manufacture of a motor mounting insulator. On the extreme left in the center are the metal parts after cleaning; next they are shown after sandblasting and cementing; after which the uncured rubber stock appears; then the cured part with flash, and finally the cured and trimmed finished mount.



Display board for use in connection with rubber technology course at Wayne University sponsored by the Detroit Rubber & Plastics Group. Prepared by employes of Baldwin Rubber Co., it shows in the middle section important steps in the manufacture of a motor mounting insulator. Grommets and gaskets are located in the upper left; brake, accelerator and clutch pedals, in the upper center; some footwear and matting products, in the upper right; and many other automotive electrical system parts and automotive weatherstripping at the bottom of picture

Atomic Energy in Peacetime

A TALK on "Peaceful Applications of Atomic Energy" by Capt. J. O. F. Dorsett, U.S.N., highlighted the April 1 spring meeting of the Rhode Island Rubber Club, held at the Metacomet Golf Club, East Providence, R. I., with 160 members and guests attending. The speaker was introduced by Capt. O. P. Lattu.

Using charts as illustrations, Captain Dorsett revealed that atomic power today is more economical as a source of power than a large bituminous coal power installation. Atomic energy can be the answer to the problem of depleted coal and oil reserves if the increase in electrical energy consumption of the past 50 years continues at the same rate.

Even the smaller atomic power plants not economically feasible at present in the United States can be the answer to the power problems of other countries not blessed with our power producing means, the speaker said. Education and understanding, coupled with cooperative determination to work together for peaceful ends, can bring about the use of atomic energy to raise standards of living to undreamed of heights.

Captain Dorsett also reported on successful peacetime applications to date of atomic energy, including the use of radioactive iodine for combating thyroid cancer; various radioactive isotopes used to study plant and animal processes; and beta-ray thickness gages which are used for sheet materials.

Chicago Rubber Group Silver Jubilee Meeting

Past Chairmen of the Chicago Rubber Group Honored at the Silver Anniversary Meeting *(Left to Right)*: **K. Sidell; J. P. Sheridan, New Jersey Zinc Co.; U. H. Parker; W. S. Chinery; H. A. Winkelmann; B. W. Hubbard; O. J. Urech; H. B. Underwood; W. H. Peterson, Enjay, Inc.; F. S. Frost, Jr., Frost Rubber Works; J. K. Kirschner; C. W. Frick, L. J. D. Healy; C. S. Yoran; and E. T. Meyer**

THE twenty-fifth anniversary of the Chicago Rubber Group was celebrated at a special meeting on March 26 at the Furniture Club, Chicago, Ill., at which the Group's founders, old timers, and past chairmen were honored. About 300 members and guests attended the affair, which included a cocktail hour, with an oyster bar operated by O'Connor & Choate, Inc.; dinner; and after-dinner technical meeting featuring a panel discussion of "Test Methods and Equipment for the Rubber Industry."

M. J. O'Connor, of O'Connor & Choate and chairman of the anniversary committee, spoke briefly on the history of the Group, tracing its growth to its present membership of more than 600. Special tribute was paid to Ben Lewis, Witco Chemical Co., and Carl Frick, Van Cleef Bros., cofounders of the Group. Life memberships were awarded to Lewis, Frick, and the past chairmen who served 10 or more years ago and have maintained an active interest in the Group. Those who were so honored were J. K. Kirschner, Dryden Rubber Division of Sheller Mfg. Corp.; W. S. Chinery, Industrial Rubber Goods Co.; H. B. Underwood, Minnesota Mining & Mfg. Co.; L. J. D. Healy, consultant; K. Sidell, W. H. Salisbury & Co.; O. J. Urech, Sam'l. Bingham's Son Mfg. Co.; U. H. Parker and H. A. Winkelmann, both of Dryden; C. S. Yoran, Brown Rubber Co.; E. T. Meyer, Herron & Meyer of Chicago; and B. W. Hubbard, Ideal Roller & Mfg. Co. Other past chairmen who were unable to attend the meeting were A. H. Voss; G. E. Ellinwood; and S. Collier, Johns-Manville Corp.

R. H. Barbour, Chicago Rawhide & Mfg. Co., acted as moderator of the panel discussion, and the panel members were Rolla H. Taylor, Scott Testers, Inc.; William Kohler, Precision Scientific Co.; R. Schmuckal, Ford Motor Co.; and W. D. Brown, Chrysler Corp.

Mr. Taylor discussed the development of the tensile testing machine, and predicted that testing of rubber properties will become more complex in the future. To keep pace with such tests the testing machine will require more instrumentation for precision. The speaker also suggested that compounders strive to make their tests more precise and more fundamental.

Mr. Kohler reviewed the development of the oven accelerated aging test method, with particular reference to the use of mechanical air convection, baffle plates, outside motors to eliminate ozone contamination, and temperature controls.

Dynamic testing of rubber products was discussed by Mr. Schmuckal, who characterized this field of testing as being not well known at present. Products for which dynamic tests are used to simulate actual service conditions, rather than static tests which are unreliable, include automobile V-belts, radiator hose, motor mounts, and axle bumpers.

Mr. Brown spoke on the work of the mechanical rubber goods industry in providing useful door seals and weatherstripping for automobiles. The major problems to be overcome in this installation are distortion during installation, and weather aging. Molded sponge weather seals must have a thick skin over the sponge for protection, and the sponge must be compounded for low compression set. Since a good cement bond between car body and seal is necessary, the surfaces of the seal must be free from mica or other materials that would interfere with adhesion.

Higher Oil Content Experimental Polymer

X-763, a cold oil-black masterbatch polymer, identical with GR-S 1801 except for changes in the amount and type of contained oil employed, has been announced as available for evaluation by the Reconstruction Finance Corp., Office of Synthetic Rubber, Washington, D. C. The new polymer, in limited production as a result of requests for a material with such deviations in the oil type and content, will replace GR-S 1801 if customer investigations prove its worth.

The composition of X-763 is given as follows: 37.5 parts aromatic oil; 50 parts HAF black; 23.5% bound styrene; sugar-free iron activated; 50/50 rosin/fatty acid soap emulsified; 41° F. reaction temperature; 60% conversion; carbamate short stopped; staining stabilizer; salt-acid coagulated; and Mooney of masterbatch (compounded), 55-75 ML-4. It will be noted that GR-S 1801 contains only 25 parts of a naphthenic oil.

Correction

The soap emulsified experimental polymer described in our April, 1954, issue, page 75, is designated by RFC as X-762, instead of X-672 as we reported.

Quebec Group Hears McLeod

L. A. McLEOD, Polymer Corp., Ltd., was guest speaker at the March 18 dinner-meeting of the Quebec Rubber & Plastics Group, held in the Queen's Hotel, Montreal, P. Q., Canada. A total of 88 members and guests attended and heard Dr. McLeod speak on "Recent Advances in Synthetic Rubber." There was also a showing of a color film on Polysar production operations at the Polymer plant.

Dr. McLeod's talk consisted of a brief review of different fields where new polymers are being developed; he started with a recapitulation of the improvements in vulcanizate properties achieved by the use of low-temperature rubber. The stress-strain properties of oil-extended polymers were mathematically defined, and the speaker indicated that a point will be reached as the molecular weight of the base polymer increases where more oil will be required for processability than can be tolerated for good stress-strain properties. Present oil-extended rubbers are approaching this condition, it was said.

The speaker also briefly described the production and properties of diisocyanate rubber, silicone rubber, and chlorsulfonated polyethylene. Dr. McLeod concluded with a description of the Alfin butadiene-styrene polymers and compared their properties with those of cold rubber.

Fort Wayne Group Elects

NEW officers and directors of the Fort Wayne Rubber & Plastics Group for the coming year were announced at the spring meeting on April 8 in the Van Orman Hotel, Fort Wayne, Ind. A total of 146 members and guests attended the meeting, which included a cocktail hour, dinner, and technical session featuring a talk on "Rubber Industry in General" by John H. Gerstenmaier, Goodyear Tire & Rubber Co.

The new Group officers are: chairman, Howard C. Rapp, Belden Mfg. Co.; vice chairman, Jack L. Carlson, Paranite Wire & Cable Co.; secretary-treasurer, Richard W. Flack, The General Tire & Rubber Co.; and directors, C. P. Carpenter, Western Rubber Co., Daniel Reahard, Jr., General Tire, Hugh R. Tobey, United States Rubber Co., M. J. O'Connor, O'Connor & Choate, Inc., J. F. Stiff, Binney & Smith Co., and Robert Hartman, Monsanto Chemical Co.

Mr. Gerstenmaier's talk took the form of an oral tour through the Goodyear plant, with special attention to the tube and press rooms, molding operations, and finishing and trimming procedures.

Nylon in the Rubber Industry

A TALK on "The Use of Nylon as a Textile Fiber in the Rubber Industry" by H. C. Mersereau, Canadian Industries, Ltd., was the high point of a joint dinner-meeting of the Ontario Rubber and Wellington-Waterloo sections, C.I.C., on March 9 at Kress House, Preston, Ont.

The speaker began with a statistical review of the growth of nylon consumption by the rubber industry, particularly in the form of tire cord. The properties of nylon were compared with those of rayon and other synthetics with regard to strength, elasticity, flex fatigue, adhesion, heat resistance, bacterial and chemical resistance, and ease of cleaning. Mr. Mersereau then discussed the advantages and disadvantages of nylon in rubber products such as tires, V-belts, flat belts, coated fabrics, footwear, hose wall fabrics, tape, and miscellaneous items. It was noted that many of these applications are in their early stages of development, and that further strides can be expected as technical and economic problems are solved.

Ontario Group Elects

The election of officers for the coming year took place at the April 13 dinner-meeting of the Ontario Section. Seventy members and guests attended the meeting in Hart House, University of Toronto, Toronto, Ont.

The slate of officers presented by the nominating committee, headed by J. A. Carr, Dunlop Tire & Rubber Goods Co., Ltd., and Herb Schmalz, Dominion Rubber Co., Ltd., was elected, as follows: chairman W. J. Nichol, Gutta Percha & Rubber, Ltd.; vice chairman, W. H. Bechtel, Kaufman Rubber Co., Ltd.; secretary, G. Grushcow, Dayton Rubber Co. (Canada), Ltd.; treasurer, W. A. Cline, Canadian General-Tower, Ltd.; Toronto representative, C. M. Croakman, Binney & Smith, Ltd.; Hamilton representative, R. F. Berner, Boston Insulated Wire & Cable, Ltd.; and Kitchener representative, H. K. Cunliffe, Dominion Rubber. Mr. Croakman and E. A. Kent, Canada Wire & Cable, Ltd., were named to head the golf tournament committee.

Speaker at the technical session was E. A. Sinclair, Goodyear Tire & Rubber Co., who discussed "The History, Chemistry, Processing, and Applications of Chemigum SL." Mr. Sinclair's talk was similar to that given by Dr. Dinsmore at the April 2 meeting of the New York Rubber Group (see page 236).

Summer Courses in Polymers

THE Polytechnic Institute of Brooklyn has announced the eleventh annual series of Summer Laboratory Courses, open to professional representatives from industry and institutions. Three courses will be given this summer, as follows: June 28-July 2, "Progress in Polymerization and Copolymerization Techniques"; July 12-16, "Properties of Macromolecules in Solution Including Polyelectrolytes and Other Water Soluble Polymers"; and August 23-September 3, "Industrial Applications of X-Ray Diffraction."

Each course consists of lecture and laboratory periods, and attendance is limited to assure adequate contact between instructors and participants. Inquiries should be addressed to Mrs. Doris Cattell, Secretary, Summer Laboratory Courses, Polytechnic Institute of Brooklyn, 99 Livingston St., Brooklyn 1, N. Y.

Atomic Control by World Government

A CALL for a limited world government, not just to maintain peace, but to avert annihilation of our civilization was sounded by Hubert N. Alyea, Princeton University, in a talk on "Atomic Energy: Weapon for Peace" at the April 2 spring dinner-meeting of the Akron Rubber Group. A total of 550 members and guests was present at the Mayflower Hotel, Akron, O., to hear Dr. Alyea discuss the need of impressing the political scientists of all nations with their great responsibility in this atomic age.

A world law set-up must be established to which all nations are willing to agree, the speaker declared. This calls for a world legislature, a world judiciary, and a world police force to enforce the law.

The Group also heard Elizabeth Ellen Evans, a junior at Buchtel High School in Akron, give her talk, "I Speak for Democracy," which was a national prize winner in the recent "Voice of Democracy" contest.

New officers of the Group for the 1954-55 year were announced in the business session which followed the talks. The officers are: chairman, L. M. Baker, General Tire & Rubber Co.; vice chairman, K. R. Garvick, Mansfield Tire & Rubber Co.; secretary, Harry M. Brubaker, Witco Chemical Co.; and treasurer, H. D. Harrington, also of General.

The members voted to approve a plan to establish four scholarships in chemistry at the University of Akron. Each scholarship will be $250 annually and will be financed by an increase in the membership dues. Mr. Garvick, the present membership chairman, reported that the Group has a new record high of 1,662 members.

Door prizes at the meeting were won by A. E. Juve, The B. F. Goodrich Co.; J. B. Cook, Wooster Rubber Co.; and N. Oswalt, Mohawk Rubber Co.

Fibers and Polymers Discussed

THE Elastomer & Plastics Group of the Northeastern Section, A. C. S., was host at the Section's regular meeting on March 11 at Massachusetts Institute of Technology, Cambridge, Mass. The meeting included an afternoon technical session, attended by 100 members and guests, followed by a cocktail hour, dinner, and evening meeting at which 161 were present.

E. R. Kaswell, Fabric Research Laboratories, Inc., presided over the afternoon session, which consisted of a symposium on "The Chemistry and Engineering of Fiber-Forming Polymers." Symposium speakers were George E. Ham, Jr., Chemstrand Co., who discussed "The Organic and Physical Chemistry of Fiber-Forming Polymers," and Roy W. Sudhoff, also of Chemstrand, who spoke on "The Engineering of Acrylic Polymers into Textile Fibers."

Dr. Ham's talk dealt with polymerization of acrylics and covered such topics as the effect of chemical structure on fiber properties; copolymerization of acrylonitrile with other monomers; comparison of free radical, carbonium, and carbamionic catalysis in acrylonitrile polymerization; effect of copolymer structure on dyeing of fibers; and other acrylic polymers and copolymers.

Mr. Sudhoff gave a summary of the engineering factors involved in plant design and operation, and process disposition for the manufacturing of acrylic fibers. Potential demands for synthetic fibers, filaments, staple, and tow were discussed from the viewpoint of economics and material properties.

C. R. Morgan, Arthur D. Little Co., presided over the evening session, at which Herman F. Mark, Polytechnic Institute of Brooklyn, spoke on "Synthesis and Properties of Block and Graft Copolymers."

Two Speakers for Boston Group

TALKS by Frank A. Bovey, Minnesota Mining & Mfg. Co., on "Fluorine-Containing Elastomers," and B. B. White, General Electric Co., on "Silicone Rubbers," featured the afternoon technical session of the Boston Rubber Group's spring meeting on March 26 at the Somerset Hotel, Boston, Mass. About 140 members and guests attended the session, which was followed by a dinner at which 106 were present.

Dr. Bovey's talk was similar to that given by A. M. Borders, of 3-M, before the New York Rubber Group at its April 2 meeting, reported elsewhere in this issue.

Mr. White described in detail the properties, types, and compounding of silicone rubbers. The attributes of the various fillers and vulcanizing agents were discussed, including some fine silicas not yet commercially available which show promise of producing silicone stocks having tensile strengths of 2,000 psi. or higher. The use of certain additives for producing low compression set stocks was described, and the speaker emphasized the need of cleanliness in all aspects of compounding work. The talk concluded with a review of silicone elastomer types and their recommended applications.

The talks were followed by a brief business session at which a report was presented by Alan Bryant, of Binney & Smith Co. and group education committee chairman. Mr. Bryant said that the committee plans a two-semester course in rubber technology, consisting of a two-hour lecture each week, to be given by George Hunt, Simplex Wire & Cable Co.

The after-dinner speaker was Joseph LeBlanc, who gave a humorous talk in the French-Canadian vernacular, entitled "Bateese Heemself."

ASTM June Meeting

THE fifty-seventh annual meeting of the American Society for Testing Materials scheduled for June 13-18, at the Sherman and Morrison Hotels, Chicago, Ill., will include hundreds of technical committee meetings, several symposia, and the Society's Eleventh Exhibit of Testing and Scientific Apparatus and Laboratory Supplies and its ninth Photographic Exhibit.

The twenty-eighth Marburg Lecture, on June 16, will be given by Harold F. Dodge, Bell Telephone Laboratories, Inc., on "Interpretation of Engineering Data." The third H. W. Gillett Memorial Lecture, June 15, by R. L. Templin, Aluminum Co. of America, will be on "Fatigue of Aluminum."

Committee D-9 on Electrical Insulating Materials and its subcommittees, and Committee D-11 on Rubber and Rubber-Like Materials and its subcommittees will meet June 15-17. Committee D-20 on Plastics and its subcommittees will meet June 16-18.

Society President L. C. Beard, Jr., will give an address at noon on June 15.

NEWS of the MONTH

Washington Report and National News Summary

The Rubber Facilities Disposal Commission indicated in April that it wished serious proposals at the start of its negotiations to begin May 27 for the sale of the government owned synthetic rubber plants, so that "horse trading" could be minimized. Rep. Paul W. Shafer also warned in Congress against "token bids." Industry spokesmen were generally optimistic that a successful disposal plan could be worked out.

The board of directors of the University of Akron sent to the Rubber Facilities Commission in March a proposal for the continued operation of the Government Laboratories and pilot plant by the University. Sale to the University about May, 1955, and an allotment of about $5 million from the sale of the synthetic plants were suggested to provide for work for the Armed Services and for industry on a fee basis for three years.

The Reconstruction Finance Corp.'s research and development budget for fiscal 1954 of $4,160,000 has been approved. Promising developments such as GR-S synthetic resin masterbatch, Alfin rubber-oil masterbatch, both of which have shown new and interesting properties, were explained.

There seems to be some hope that 14 years' work in connection with the rubber research program of the government in Latin America may not be abandoned prematurely.

RFC has eliminated domestic freight charges on GR-S in order to encourage export shipments.

More changes in our natural rubber stockpile rotation procedures are expected in the near future.

Final 1953 rubber industry sales, earnings, and inventory figures reveal that those for the third quarter of that year were quite a bit lower than for the first nine months, although total volume of sales was slightly more than $5 billion. First-quarter 1954 trends are mixed, with some companies reporting declines, and others gains, but as of late March generally improved sales were noted.

Washington Report by Arthur J. Kraft

Disposal Commission Indicates Desire for Minimum of "Horse Trading"; Shafer Again Warns against "Token Bids"

The Rubber Producing Facilities Disposal Commission last month spelled out the procedures it would follow in negotiating contracts for the sale of the government's synthetic rubber plants, after May 27. The statement was issued in response to queries from a number of prospective purchasers as to the Commission's plans for handling purchase proposals.

The Commission said the negotiation period would begin on May 27 and run through December 27—the seven-month period required by the disposal legislation enacted last summer. The Commission made it clear, however, that it would like to set aside the last several months of this period to prepare and execute contracts, clear those contracts with the Attorney General, and write the report which it must submit to Congress at the end of January.

Emphasis on Serious Bids

The Commission will use as the basis for negotiating the highest amount proposed for each facility and will negotiate first with the person offering the highest amount for each facility.

"While the Commission intends to afford prospective purchasers ample time for negotiation, the Commission now gives notice," the announcement said, "that it may at any time after May 27, 1954, exercise its right to accept that proposal which represents, in the Commission's judgment, the highest monetary return to the government with respect to each facility consistent with all requirements of the Act, and thereafter to proceed with the preparation of contracts of sale."

Taken together, what this announcement amounts to is an effort by the Commission to induce prospective bidders to put forth serious proposals right at the start. The Commission does not want to be faced with a prevalance of bids offering only token prices, necessitating time-consuming haggling to get the price offers raised. The Commission would like to wind up negotiations for most of the plants as rapidly as possible, leaving adequate time to concentrate on attracting offers for the remaining plants.

The Commission is well aware that its job—perhaps best described as a "slow auction"—will involve much free-swinging negotiation. Prospective purchasers outbid for the plant of their first choice, or even their second choice, will be both permitted and encouraged to enter new bids for another plant, well after May 27. If prospective purchasers, or the Commission itself, approaches the job in the spirit of horse-trading, much time could be wasted, and prospects of coming out with an acceptable disposal program would be jeopardized. Judging by its announcement of the post-May 27 procedures, the Commission wants to get off on the right foot.

Shafer Comment

This seems also to be the desire of at least a majority of the prospective bidders. On March 31, Rep. Paul W. Shafer (Rep., Mich.) made a speech on the House floor sharply criticizing one or two of the Akron companies for taking a rather dim view of the money-making potential of the rubber plants for private owners.

Officials of these firms described their feelings in a newspaper interview, datelined Akron, which ran under the heading, "Rubber Makers Fret about the Advisability of Buying Plants Owned by Government." The company, which was not identified except as being among the "largest" in that city, was quoted as stating of the disposal program:

"The only thing that makes it worth while is getting the government out of our business. From a dollars-and-cents standpoint, it just doesn't make sense."

A spokesman for another firm, according to the article, echoed that sentiment in these words: "We're going to bid on three plants. But frankly we'd like to end up with none."

Mr. Shafer was quite perturbed and said so. Mincing no words, he described such talk as the "whittling down strategy" designed to scare off other bidders, and he deplored the "faint hearts" in the rubber industry who, by such talk, demonstrated a lack of faith in free enterprise.

"I want to serve notice right here and now," the Congressman declared, "that if anybody in private industry entertains the idea of buying one of these facilities at a giveaway price, they will get that facility only over my violent objection. Or if anyone in the rubber industry, having been under government control so long, wants only to pay lip service to the theory of private enterprise and is not willing to invest in the future of this nation and the private enterprise system, then believe me, if he is successful, he will get all the government he wants, and perhaps more.

"You know," he told his fellow legislators, "there is a strange thing about the entire synthetic rubber program which many people don't realize and that is, the rubber industry has done very well under this government program. It is rather nice to operate a business where you can buy your materials from a government source at a fixed price and under a system where you used to be able to turn the spigot on and off without cost to the customers. [This was changed last autumn, when the government began to require firm, advance orders for synthetic rubber from its larger customers—AJK.] And it was nice of the government to warehouse the inventory for private enterprise. So maybe there are one or two in the rubber industry who have adopted the theory that if they can't buy the plants for peanuts, then they'd rather have the government stay in the business.

"What I am getting at is this: The Congress authorized the sale of these facilities and set up certain standards. But if anyone thinks that the Congress is

going to be fooled by a lot of scare talk and a lot of 'I'm not interested' talk, then they don't know the Congress of the United States! If industry doesn't want to buy these plants, or if industry is only willing to submit token bids for these plants, then industry might just as well know now that the government is going to be in the rubber business from here on out; perhaps even on an increasing scale. And as far as I'm concerned, if the government stays in the rubber business, then the government must operate the plants in such a manner as to recover every penny invested in these plants." [Freely translated, Mr. Shafer is serving notice that if disposal fails, the government will boost the price at which it supplies synthetic rubber substantially above the present 23¢ a pound for GR-S to recover the remaining unrecovered government investment, an estimated $450 million—AJK.]

The response to Mr. Shafer's speech was a good tip-off that the rubber companies, by and large, are serious about making the disposal program a success. Goodyear, General Tire, and Seiberling immediately wired Mr. Shafer that the newspaper article did not reflect their sentiments and that their officials made no such statements to the interviewer. At least one other of the Akron rubber firms informed the Congressman that its officials made no such statements to the newspaper. So far, no one has admitted having made the statements carried in the article.

The Disposal Commission, in effect, sounded the same note as Mr. Shafer in announcing its negotiating procedures. At the same time, the Commission made two other announcements:

Other Actions

1. It designated five Federal Reserve Banks (New York, Chicago, Cleveland, San Francisco, and Dallas) to receive and hold the deposits made in support of purchase proposals.

2. It modified the National Security Clause which will be written into each sale contract to make clear that: (a) the 180-day period for reactivating or reconverting a plant will be extended in extenuating circumstances, such as inability to procure essential materials, unavailability of labor, act of God, fire, earthquake, strike, or other cause "reasonably beyond the control" of the plant owner; and, (b) instead of restoring the plant to production of the material produced at the time it was sold by the government, the owner may elect to substitute new, separate facilities making a like quantity of a comparable product. Thus, if a copolymer plant making GR-S were shut down, the owner—ordered to reactivate it—could offer the government a plant making another, presumably newer type of general-purpose rubber.

The Rubber Producing Facilities Disposal Commission on April 22 inspected the two government synthetic rubber facilities at Naugatuck, Conn., the copolymer (latex) and dodecyl mercaptan plants operated by United States Rubber Co. These were the last of the government rubber plants visited by the Commission. In February the Commission had inspected 19 plants, and in March it inspected six others.

Making the trip to Naugatuck were Chairman Holman D. Pettibone; Vice Chairman Leslie R. Rounds; Executive Director Eugene Holland and his assistant, Morris Heins; Secretary Ferris B. Thomas; and Legislative and Press Liaison Officer Don Hogate. The party was accompanied, as on the previous inspection trips, by E. Dorrance Kelly, Director of RFC's Office of Synthetic Rubber. Commissioner Everett Cook did not make the trip to Naugatuck.

Akron U Proposal on Government Laboratories

The board of directors of the University of Akron prepared and sent to the Rubber Producing Facilities Disposal Commission in March a proposal for the continued operation of the Government Synthetic Rubber Evaluation Laboratories and Pilot Plant by the University. The Commission realizes its responsibility in providing recommendations for the future of the Government Laboratory, but it is one of its problems that may not receive attention until the plant disposal program has taken more definite shape. The Laboratory itself is not up for disposal at the same time as the plants.

The University of Akron recommendations were as follows:

(1) That the Commission sell the facilities of the Government Laboratories to the University of Akron for a nominal sum, effective about May 1, 1955.

(2) That the Commission recommend the appropriation of $5 million from the sale of the synthetic rubber producing facilities to the Universty to enable the Government Laboratories to supply research and development work for the Armed Services for a three-year period. This arrangement would also permit the University to accept research contracts from industry on a fee basis.

(3) That the Commission recommend the National Science Foundation, or some other appropriate government agency, be authorized to screen and assign research projects originating from the Armed Forces and to supervise the annual operating budget for the military program as well as expenditures for capital improvements.

(4) It was further recommended that at the end of the three-year period the University of Akron agree to continue operating the facilities on the basis of fees received from agencies of the Armed Forces and from private industry; or, if this procedure is not possible, continue to operate the facilities under an additional appropriation allocated by Congress through the National Science Foundation, or some other government agency. Finally, if neither of the two above methods works out, the title and property, plus any unused portion of the original $5 million is to be returned to the proper U. S. government agency.

In connection with the $5 million appropriation it is pointed out that this sum is justified because of the importance of continuing research in synthetic rubber for national security reasons. An annual operating budget of $1.2 million and an additional sum of $1.4 million is contemplated for the three-year period. The volume of military work to be paid out of the proposed budget is to be limited to $100,000 per month, and if more than this sum is required, it is to be undertaken on a cost plus an overhead fee of 5%.

In order to supply the need of expanded basic and applied research contemplated by industry, any program that would not interfere with the military programs in the opinion of the National Science Foundation should be accepted from private industry on a cost plus an overhead fee of 10%, on a first-come-first-served basis. The results of such development work would be the exclusive property of the company paying for the program, unless prior arrangements for publication in the scientific literature were made.

The Akron University proposal explains that industry spokesmen have stated that when the synthetic plants are under private ownership, the research program sponsored by industry will be greatly expanded, and by making its facilities available to private industry on a fee basis, the Government Laboratories will obviate the necessity of industry duplicating costly equipment, at least at present.

Also, industry has indicated its reluctance to assume certain types of research and development for the Armed Forces; the budgets of the Armed Forces have been cut; and it thus appears justifiable to set aside a modest sum from the sale of the synthetic plants to continue research and development for the military establishments.

Finally, it is pointed out that it would be ill advised and uneconomic to break up the highly trained and experienced research and development staff when a new industry so vital to national defense is still in its infancy.

RFC Research Cut to $4 Million; Recent Activities Described

In a release dated April 8, Laurence B. Robbins, Acting Administrator of RFC, announced the approval of a $4,160,000 research and development program for synthetic rubber for the fiscal year ending June 30, 1955. This program is a continuation of work that has been carried on in the past, but most recent annual budgets have been between $6 and $7 million.

The explanation of the use of these funds in the April 8 release was supplemented by an additional release on April 20, by the Office of Synthetic Rubber Research, which gave somewhat more detailed technical information.

Emphasis will be on improving the quality of synthetic rubber for more extensive use in large-size tires and on assisting national defense groups in their search for better synthetic rubber for special purposes, it was said.

The current research program will be conducted for RFC by eight industrial organizations operating GR-S production plants; by the Government Laboratories at Akron, O.; by a tire testing contractor in San Antonio, Tex.; and by 11 other contractors including universities and research institutes.

The most noteworthy activities of the research program in the past year were:

A comparison between natural and synthetic rubber in both passenger-car and truck tires reveals that passenger-car tires made with LTP GR-S in the treads outperform tires made of all natural rubber, and that oil-extended GR-S further improves tread wear in passenger-car tires. Large truck tires containing up to 30% GR-S approach tires made of all natural rubber in performance on road tests.

Naphthenic Oils Best

Tire tests of oil-masterbatched GR-S show a cycloparaffin concentrate oil to give the best tread wear. It has also been established that the oil components known as "nitrogen bases" are detrimental and must be limited. Of the three classes of masterbatching oils covered by Office of Synthetic Rubber specifications, naphthenic oils are closest in composition to cycloparaffin concentrate and contain the smallest proportion of nitrogen bases. However the aromatic and highly aromatic oils, as defined in the specifications are entirely satisfactory within the limits of normal commercial use.

Resin Reinforced GR-S

For more extensive use of synthetic rubber in heavy-duty tires, improvements are being sought in the polymer in the direction of lower hysteresis and greater tensile strength. In reinforcement studies a means of lessening heat build-up, while maintaining tensile strength, has been indicated. Thus 20 parts of a special vinyl polymeric filler such as cross-linked polystyrene, added by latex blending, is nearly equivalent to 50 parts of HAF black in tensile strength and superior in heat build-up. Also, 0.5 to 2% polymeric vinyl acid such as polyacrylic acid, coprecipated with GR-S 1500, results in a product which can be reinforced by 25 parts of HAF black to give tensile properties equal to the usual 50 parts HAF tread compound. Additional pilot-plant work will be required, however, to prove the practicability of these combinations.

The solution to the problem of a synthetic rubber completely adequate for heavy-duty tires will probably come from a better understanding of the properties and structures of known elastomers, it was added. Such properties as molecular weight, molecular weight distribution, and polymer configuration are being investigated by the use of modern scientific tools including a high-frequency electrical beat method, an electronic digital computer, birefringence, and infrared spectroscopy. From these studies has come a theory of flow of visco-elastic materials which successfully accounts for such phenomena as non-Newtonian viscosity and dynamic behavior. A new approach to obtaining polymers of desired chain length and configuration is the use of disulfide modifiers to give reactive end-groups.

Reaction Kinetics and Latex

Fundamental studies are being made of the mechanisms and kinetics of the various chemical reactions involved in producing synthetic rubber. From these studies should come new and more efficient activators, initiators, modifiers, and short-stops, the RFC research office said.

Cold, high solids synthetic latex for use in the rapidly expanding foam sponge market has been produced with improved properties such as viscosity, color, and odor, by means of a new catalyst, sodium formaldehyde sulfoxylate (SFS).

New Mercaptan Modifier

Commercial primary dodecyl mercaptan (DDM) made from commercial lauryl alcohol, the latter obtained from imported cocoanut oil, may now be replaced by primary tridecyl mercaptan made from tridecyl alcohol, a petrochemical product. The new modifier has been proved to be fully equivalent and relieves the necessity of depending on foreign material sources in times of emergencies.

New Arctic Rubber

GR-S produced at 122° F. with a Nitrazole catalyst has shown advantages for rubbers for use at —40 to —80° F., because it resists crystallization better than LTP GR-S and yet has tensile properties superior to 122° F. GR-S. While this type may not come into general use, it shows promise for special applications for rubber parts required for military service in Arctic regions.

Alfin Rubber

Alfin polymerization is conducted in the absence of water, using a catalyst composed of allyl sodium isopropoxide, and sodium chloride. It permits the preparation of benzene-soluble (gel-free) polymers of extremely high molecular weight. Alfin polybutadiene has been extended with equal parts of processing oil, yet maintained a tensile strength and elongation of about 2500 psi. and 650%, respectively, in a tread-type recipe. Additional development of Alfin polymers in the pilot plant is required to establish conditions for their uniform preparation on a larger scale and to determine the best composition for satisfactory processibility in rubber product factories, it was said.

Synthetic rubber prepared with metallic sodium as a catalyst has given excellent results in tire bodies although it cannot compete with LTP GR-S for tread stocks. This system eliminates the soap solution.

Natural Rubber Research

In studies of the biosynthesis of natural rubber to determine the mechanism of its formation, the selective utilization of isoprene glycol by *Cryptostegia* seedlings is being followed by radio-carbon tracer techniques. Synthesis of three compounds, possible natural intermediates, have been completed; these compounds will be subjected to preliminary plant growth tests.

Publication and Planning

The results from research from all participants in the RFC program are published as rapidly as they can be technically edited. During the past year 111 articles were published in technical journals.

RFC formulates the overall research program each year and with the aid of interrelated committees develops detailed plans, maintains a balance between fundamental, applied, and developmental research, and facilitates a continuous exchange of research findings.

Latin America Rubber Research Outlook Hopeful

The future home and scope of this government's natural rubber research program for Latin America were still in doubt in late April, but with prospects of a high-level decision coming down in a matter of weeks.

The 14-year-old regional research program, administered by the United States Department of Agriculture, has been threatened with termination on June 30 as a result of the decision by the Foreign Operations Administration, its financial angel, to withdraw its funds after that date.

FOA has taken the position that its charter from Congress prohibits use of technical assistance money for regional research and development. Under its charter, FOA believes U. S. financing must be on a country-by-country basis, with each recipient government putting up funds matching the American contribution.

USDA has pointed out that participating Latin American governments have contributed far more to the regional rubber research and development program by way of land and other facilities. FOA, however, has insisted the reciprocal contributions must be in the form of cash.

USDA's approach to regional research has been to establish a small staff of experts in one country to serve an entire region. The principal rubber research center serving the nine participating Latin American countries is in Costa Rica.

Secretary of Commerce Sinclair Weeks two months ago urged Agriculture Secretary Ezra T. Benson to take over the program entirely from FOA, and, if necessary, to seek a separate appropriation from Congress for USDA to run the program. USDA figures it could operate at $500,000 for the coming fiscal year.

However Mr. Benson questioned the propriety and the authority for USDA, on its own initiative, taking over the program, chiefly on the ground that a Presidential directive of June 1, 1953, gave to FOA the responsibility over all technical assistance projects. Mr. Benson feels that while USDA cannot take the initiative, it could assume responsibility for the rubber program were an exception to this directive issued by the President or Defense Mobilizer Arthur Flemming.

For this reason Mr. Benson last month requested ODM, FOA, and other interested agencies to decide on these three questions: (1) How significant is the Latin American rubber research program to this country's national interest? (2) Should USDA take full charge of the program? (3) Who should supply the funds? The decision-making was put up to top policy officials of these agencies, a course suggested by lower echelon opertaing officials at a meeting held April 12 under the auspices of ODM. Attending the meeting were representatives of ODM, the Commerce and Agriculture departments, and FOA.

They also agreed to indefinite postponement, pending a final disposition of the issue, of the transfer to FOA, scheduled for April 25, of USDA's foreign field personnel engaged in rubber research.

Some of the major losses that would be incurred by letting this 14-year effort collapse at a time when it is on the verge of producing its most valuable contribution to tropical agriculture, are as follows:

1. Fourteen years of exploratory and research effort by the U. S. Government and cooperating governments based on two experimental farms in Costa Rica.
2. More than 500 assembled clones and hundreds of clonal seedlings now in the field, but still in the immature stage.
3. Twelve thousand three-component trees ready to be moved to permanent field locations in the July-October period.
4. Yield data from clones in plantings now in their first year of production, some of which are showing promise.
5. Loss of the progress made toward selecting the first phytophtora-resistant (black stripe—attacks tapping outlets of trees) *Hevea* clones ever developed anywhere in the world.
6. Inadequate time to rebud and transfer most of the valuable new clonal material to locations where it may be preserved.
7. The five-year research project which has brought the possibility for the first time in rubber history of having clonal rootstocks for field planting.
8. The disease resistance testing work in Costa Rica which it has not been pos-

sible to duplicate in any other part of the hemisphere because of climatic and other conditions.

It has been recommended that the regional research program should be continued somehow on at least its 1954 level for a number of years with periodic reviews by world rubber experts of industry and government to determine its progress and direction.

Help for Southeast Asia Rubber Urged

Immediate stop-gap action by the U. S. Government to help dispose of Indonesia's rubber surplus was urged in a report issued here March 28 by a special Congressional study mission on its return from Southeast Asia and the Pacific.

The four-member mission, headed by Rep. Walter H. Judd (R., Minn.), made the study trip to gather an up-to-date picture of the political, military, and economic situation in the area for the House Foreign Affairs committee. Rubber was dealt with only briefly in their 106-page report.

Speaking of the area generally, the Congressmen concluded: "The 'impact' phase of economic assistance is nearing its conclusion in most countries. In view of the limited funds and the chronic difficulty in securing suitable personnel, emphasis should be on technical assistance projects and not commodity programs, *except* where the military situation may require some commodity support."

The principal exception, in the study mission's view, is Indonesia. Here's what it reported:

"Indonesian leaders inquired of the study mission the policy of the United States on Indonesian surpluses of rubber. The members of the study mission pointed out that the United States with all of its skills and its large internal market is also burdened with surpluses in certain commodities which it cannot readily dispose of. The whole problem of surplus commodities in any country is a complex and difficult issue that goes well beyond simple economic factors and cannot be solved quickly. . . . There is a tendency in countries producing natural rubber to blame the United States for low world prices because of the competition from American artificial rubber (synthetic) plants. The experiences of World War II have taught us that we dare not allow ourselves to depend solely on foreign sources for such a vital commodity as rubber that might again be cut off in time of war. The disturbed conditions in, and Communist attacks on, Asia strengthen that view.

"The United States is desirous of achieving stable world prices through international efforts. Because the situation is so urgent in Indonesia, the study mission is of the opinion that the United States should make a special effort to work out a more immediate arrangement that will give that government some assistance pending a broader world settlement."

As for Malaya, the study mission reported that the "keystone of Malaya's economy is rubber and tin, the major portion of which is exported to the United States. . . . The price slump in these commodities since 1952 has brought about a considerable recession, losses in value of exports, in dollar exchange, and in government revenue from export taxes. In the rubber industry it has created labor problems resulting from reduced wages. Internally the Communist attacks have added to the difficulties of these industries.

"Reliance upon two commodities, together with a heavy rice deficiency, have pointed up the need for greater diversification. Other important products, many of which are susceptible of further development, are iron ore, bauxite, palm oil, cocoanut oil, pineapples, timber, fisheries products, cocoa and hemp."

RFC Eliminates GR-S Domestic Freight Charge on Export

RFC acted last month to stimulate exports of GR-S by, in effect, reducing freight charges on rubber purchased for shipment overseas. The agency agreed to sell GR-S destined for export on an f.o.b. producing plant or warehouse basis, beginning with April deliveries.

The move represented abandonment of the 1.1¢ uniform freight charge hitherto applied by RFC to export shipments. That uniform freight charge, however, continues to apply to domestic shipments as well as to exports, to such as Canada and Mexico, moving by overland or coastal water routes.

The new procedure for export rubber is expected to result in a saving of about 0.7¢ a pound in freight costs. This expectation is based on the fact that abundant supplies of GR-S now are available to exporters at plants and warehouses in the Gulf Coast area.

Cost of freighting this rubber to nearby ocean ports is an estimated 0.4¢ a pound, or about seven-tenths less than the 1.1¢ uniform freight charge applied heretofore, regardless of the distance the shipment traveled in moving from a producing plant to port.

The RFC action was a partial return to the f.o.b. plant selling policy in effect for all GR-S sales—domestic and export—prior to 1952. The uniform freight charge procedure was adopted at that time primarily at the request of exporters, to permit them to quote firm prices to overseas accounts. Because of the tight supply of GR-S prevailing over the past few years, exporters found it difficult to quote firm prices when they could never be certain which of RFC's widespread plants would supply the rubber and whether the freight cost for this rubber would be large or small.

Exports of GR-S averaged more than 2,000 tons a month in the first half of 1952, prior to the adoption of the uniform freight charge policy. The high price of natural rubber helped stimulate overseas demand for synthetics. Over the past year, however, with natural rubber available to European customers at low prices, exports of GR-S have run between 500 and 1,000 tons a month. RFC is hopeful that the lower freight costs which will result from its recent action will make synthetics more competitive price-wise in the European market.

Ocean freight and insurance costs to Europe average about 2¢ a pound, bringing the laid down cost in Europe to about 25.4¢ for straight-run GR-S sold here at 23¢ a pound, after adding in the 0.4¢ average for shipping GR-S from a Gulf Coast plant or warehouse to a Gulf Coast port.

RFC Rubber Output, Sales

RFC announced in April that it would produce about 33,000 long tons of GR-S in July and estimated sales during that month would run about 34,000 tons. The announcement, made April 21, also scaled down previous estimates of May and June output, as follows, May, 34,980 tons, and June, 34,300 tons. This estimate was slightly under the figures released March 18, when RFC anticipated May and June output at 35,400 tons each month.

The agency reported government-held inventory of GR-S as of March 31 at about 89,400 tons, an increase of 5,000 tons from the February 28 figure. The reduction in May and June production schedules was ordered, RFC said, to "effect a more satisfactory inventory position" in line with the Budget Bureau's directive of last year limiting the June 30, 1954, inventory to 85,000 tons.

The April 21 release made no change in sales estimates for May and June, 37,000 and 32,500 tons, respectively, the same as forecast March 18. The estimates for July sales were based on purchase orders received from large consumers, who are required to place firm orders 90 days in advance of delivery. All figures include the oil content of oil-extended rubbers, but exclude carbon black used in black masterbatches.

On the same date as this release RFC reported another downward revision in its April production schedule for GR-S. Here's the chronology: on February 24, RFC estimated April output at 37,250 tons; on March 18, this was scaled down to 35,500 tons; in mid-April, it was further reduced to an estimated 34,150 tons.

The agency reported actual sales in March, as follows: total GR-S (net plus oil), 38,267 tons; LTP GR-S (net plus oil), 26,537; black masterbatch (gross weight), 4,483; oil masterbatch (gross weight), 9,668; oil-black masterbatch (gross weight), 2,066; GR-S latex, 3,989; and Butyl (GR-I), 6,528. The tentative production schedule reported for April, on a comparable basis, is as follows: 34,150 tons; 24,410 tons; 3,750 tons; 7,500 tons; 2,500 tons; 3,700 tons; and 5,990 tons.

Plans Butadiene Plant

A privately financed petroleum butadiene plant may be constructed in west Texas by Warren Petroleum Co., Tulsa, Okla., and other independent oil interests in Dallas, Tex. Plans have been made to construct a 100,000-ton-a-year plant, to cost an estimated $27 million. Initial construction of a 25,000-ton unit will be followed by additional units if the market for the butadiene can be assured. Offers have been made to supply butadiene at 14¢ a pound on a five-year contract basis.

Backers of the prospective west Texas butadiene plant believe that the future operators of the government synthetic rubber plants can absorb 25,000 tons or more a year of butadiene despite the availability of 529,000 tons of butadiene from the presently government-owned butadiene plants. If the demand for this additional butadiene reaches 50,000 or more tons a year, a cost lower than 14¢ a pound is also likely.

A spokesman for the Rubber Facilities Disposal Commission stated in late April that "press reports of the proposed construction of new butadiene facilities in Texas supports the Commission's position that there could be a

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shortage of this material under certain circumstances such as greatly expanded synthetic rubber production and new markets for butadiene developed through research. The competitive bidding interest in the eight butadiene plants now offered for sale by the Commission further substantiates this position."

Justice Department Answers Industry on Tire Quantity Discount Rule

The Justice Department in late March and early April filed answers in Federal District Court here to suits brought by 19 tire manufacturers challenging the constitutionality of the Federal Trade Commission's quantity discount limit rule for replacement tires and tubes.

Stanley N. Barnes, Assistant Attorney General in charge of the antitrust division, pledged that the FTC's case "will be defended vigorously and . . . we shall do all in our power to secure a decision upholding the quantity limit rule."

His assurance was given in a letter to the National Federation of Independent Business, which claims credit for instituting the proceedings in 1947, which culminated in the issuance of the Q-L rule by FTC five years later. The rule was issued under the quantity limit proviso of the Robinson-Patman Act—a proviso never before (or since) used prior to its application to the tire industry in January, 1952. The Justice Department acts as attorney for the FTC before the courts.

The government's replies will launch the long-deferred court trial testing the constitutionality of the Q-L rule and the procedures followed by the FTC in preparing and issuing the ruling. The 19 tire makers have asked the court for a permanent injunction, voiding the Q-L rule. Under temporary injunction since March, 1952, the Q-L rule would prohibit tire manufacturers from granting quantity discounts greater than those customarily offered their customers on a single carload shipment of 20,000 pounds.

FTC imposed this limitation after finding that only a relatively few tire distributors were able to take advantage of the heavier discounts available to large-scale buyers. As a result, FTC concluded, a great many smaller dealers, lacking the buying power to qualify for big discounts, were faced with unfair competition and threatened with injury to their economic survival. These findings also have been challenged by the tire manufacturing companies.

More Stockpile Rotation Changes Imminent

At this writing the government is believed only a few weeks away from a final decision on further modifications of the natural rubber stockpile rotation procedures to be followed by the General Services Administration.

The first step in modifying the program, as a result of criticism directed against it, was taken last December when GSA agreed to limit monthly rotation transactions to 5,000 tons, about half the previous volume. The agency applied another braking measure in limiting delivery on forward sales to the month immediately following that in which the sale is made.

Together, these measures helped meet objections that GSA was rotating too much rubber, too rapidly and selling too far ahead, with consequent depressing effect on the natural rubber market, particularly for the lower grades, which formed the bulk of the rubber pushed out into consumption channels.

At the same time these steps were announced the government also promised a "complete study of the overall natural rubber stockpile rotation program and of the grades and types of rubber which should be maintained in the stockpile." Subsequently came reports of suggestions by dealer groups that GSA call a halt to upgrading the stockpile. They urged that lower grades rotated out of the stockpile be replaced primarily by fresh supplies of generally similar grades.

The study was launched formally at a meeting January 7[1] of GSA, the Office of Defense Mobilization, and the State and Commerce departments, and a six-member subcommittee subsequently drafted recommendations, which later were accepted by the full 18-member advisory committee (nine dealers, nine manufacturers) and which have since been the subject of review by the government agencies concerned.

The proposals of the advisory group have been a well-kept secret, at least as to details. They are believed to provide something less stringent than the current rotation procedure in force since December. At present GSA is under a handicap by being required to sell for delivery no more than one month forward, because industrial users, by and large, customarily arrange for delivery of their requirements several months in advance. By May 1, for instance, the large industrial user will have signed contracts for all the rubber he will need delivered in May and all, or almost all, he will need delivered in June. He will still have room, however, on his June delivery schedule and even more room on his July delivery schedule. But GSA cannot take advantage of this situation since its current procedures prohibit it from offering in May rubber for delivery beyond June.

To ease this crimp on GSA's ability to rotate its stockpile, a scheme is reportedly under consideration giving GSA these choices:

1. During January, GSA could sell stockpile rubber for delivery in January, taking delivery of the replacement quantity in January, February, or March.
2. During January, GSA could sell for delivery in February, taking delivery of the replacement in February, March, or April.
3. During January, GSA could sell for delivery in March, taking delivery of the replacement in March or April.
4. During January, GSA could sell for delivery in April, taking delivery of the replacement in April.

(January is used as a starting point only as a matter of convenience in explaining this mechanism. In actual practice, the current month should be substituted.)

Reportedly, there is still some disagreement over whether plan No. 4 should be permitted. Under the scheme GSA, as now, would be required to contract for the replacement shipment within 24 hours of signing a sale contract.

National News

O'Neil and Richardson Optimistic on Disposal

William O'Neil, president of General Tire, following the Rubber Producing Facilities Disposal Commission's first report to Congress[2] stated that the rubber industry has a solid front in its campaign to get the government out of private industry—and to keep it out.

"Even the current low price of natural rubber hasn't dimmed the aggressiveness of the rubber industry's campaign to wrest its industry from the clutches of government control," O'Neil declared. "For the first time in 14 years our industry has an opportunity of becoming an unregimented private enterprise again."

Both the seller and the buyer must be realistic about the problems involved, he warned, however.

"For instance, the rubber industry is conscious of the fact that the ultimate buyers of the synthetic rubber plants might make less profit than the present operators receive in fees from the government. Synthetic rubber will have to stay relatively competitive with natural rubber regardless of profit . . . and today there is a differential in favor of natural rubber.

"It is necessary to sustain the synthetic rubber industry for national security purposes . . . and also in the interest of our own industrial stability," the General Tire president pointed out.

"There also must be a further realistic viewpoint on the value of the plants to the prospective buyers," he added. "In determining the sale price, part of the acquisition cost must be considered to be that expense which is immediately required for plant rehabilitation for ordinary machinery replacement and maintenance. This is the expense that would have to be met by the government if it kept the plants."

If the disposal program is kept clear of political sharpshooting, O'Neil sees a good chance for its success.

William S. Richardson, new president of Goodrich, told the Chicago Society of Security Analysts in April that prospects for the proposed sale of government owned synthetic rubber plants to private industry seem good, for apparently both government and industry are approaching the disposal program "realistically."

"Operation of a competitive synthetic rubber industry is in the present and long-range interests of our country," Richardson said. "This applies both to our national security and to our living standard, which will reflect the increasingly improved products which private industry can provide the American consumer."

[1] See our Feb., 1954, issue, p. 635.
[2] See our Apr., 1954, issue, p. 76.

Richardson said that aggressive competition in research and development would provide a healthy industry and he predicted the development of new and better synthetic rubbers once the rubber making plants are in the hands of private competing owners.

Industry 1953 Sales and Profits

The sales, profit, and other figures for six Akron rubber companies for the year 1953 were nicely summarized in an article in the *Akron Beacon Journal* for March 21 by Joseph E. Kuebler. This writer pointed out that sales and other income for Goodyear, Firestone, Goodrich, General Tire, Seiberling, and Mohawk Rubber amounted to $3,191,367,000. He then went on to show where the more than $3 billion went in the following manner:

Materials, operating costs, transportation, fuel, power, etc.	$1,892,947,000	59.3%
Wages and salaries, plus social security taxes, insurance and pension plans	894,633,000	28.0
U. S., foreign taxes	174,274,000	5.5
Depreciation	73,109,900	2.3
Interest on loans	15,579,000	0.5
Reserves for emergencies	3,211,000	0.1
Dividends to 95,250 stockholders	46,268,070	1.4
Retained in business for expansion, etc.	91,751,930	2.9

In another summary sales and profits were given, and the percentage gain or loss compared to that of 1952.

	1953 Sales	% Gain or Loss from '52	1953 Profits	% Gain or Loss from '52	% Ratio Prof./ Sales	Earning Share
Goodyear	$1,210,508,783	6.3	$49,323,167	26.4	4.1	$10.28
Firestone	1,029,402,035	6.1	46,748,971	8.5	4.5	11.77
U. S. Rubber	838,451,068	−1.4	32,732,300	16.2	3.9	5.19
B. F. Goodrich	674,613,276	8.1	34,226,745	5.9	5.1	8.16
General	205,371,098	10.4	*7,431,802	3.9	3.6	5.87
Armstrong	62,290,322	12.0	1,719,340	4.0	2.8	4.16
Mansfield	59,078,904	6.0	927,005	−30.0	1.6	1.68
Dayton	57,922,461	7.2	1,602,203	7.0	2.8	2.57
Lee Rubber	46,302,361	2.0	1,674,128	−5.0	3.6	6.31
Seiberling	40,351,305	−3.1	1,035,740	9.0	2.6	2.10
Cooper	22,952,000	34.5	359,284	11.5	1.6	2.29
Mohawk	16,263,781	−15.1	413,321	−39.5	2.5	2.92

(−) Indicates decline.
*Profit figure includes $1,156,664 as General's share of earnings of its radio and television subsidiary not consolidated in profit and loss statement.

The total sales for these 12 companies in the rubber industry amounted to $4,263,497,394 in 1953, and the total of the profits adds up to $178,192,006.

Additional figures for 1953 sales and inventories are contained in the table below taken from U. S. Department of Commerce reports.

Commerce Department 1953 Sales and Inventory Figures

Information obtained from the Office of Business Economics, U. S. Department of Commerce, through its "Industry Survey" issues for January, February, and March, 1954, provides sales and inventory figures for the year 1953 for the rubber industry.

It is interesting to note that the total of manufacturers' sales from these figures is $5,016,000,000, considerably lower than the year-end estimates of between $5.5 billion and $5.25 billion made by leading industry executives. The reason is apparent in the fourth-quarter figures, which showed a sizable decline compared with figures for the other nine months of 1953.

Most recent figures for manufacturers' sales for January, 1954, indicates a further decline to $310 million on a seasonally adjusted basis.

First-quarter 1954 sales and earnings reports show a mixed trend from the few companies reporting. Goodyear's Litchfield told stockholders at the annual meeting on March 30 that business was "off a little" from that of 1953. A 6.5% decrease in sales and a drop of 4% in earnings were reported by Firestone for the first quarter of this year. Seiberling indicated that sales in January and February were down about 10% from 1953 figures, but in late March a marked improvement was noted.

U. S. Rubber told its stockholders at the annual meeting on April 20 that earnings in the first quarter were up slightly over those of the same period a year ago and that sales in March were 16% above the recent low point of November, 1953. Goodrich spokesmen maintain that the tire industry will have an excellent year and add that 35% more money will be spent by their company this year than in 1953 for new and improved facilities. An expenditure of $35 million for new and better facilities in 1954, compared to $23 million for the same purpose in 1953, is planned.

Net sales of General Tire for December, 1953, January and February, 1954, were reported at more than $44 million, or about 1% more than for the same period 12 months ago.

RRA Objects to Recap Standard

Gilbert K. Trimble, Midwest Rubber Reclaiming Co., and president of the Rubber Reclaimers Association, in a letter to Edwin W. Ely, chief, Commodity Standards Division, U. S. Commerce Department, under the date of April 5, objected vigorously to sponsorship of the government together with the National Association of Independent Tire Dealers of a voluntary standard for the recapping of automobile tires.

The standard in question is entitled, "Recommended Revision of Treading Automobile and Truck Tires, CS-108-43"; Reference No. TS-5197, distributed in February.

The Reclaimers Association president states that he is sure the motives in back of this move are of the highest order, but the standard represents the views of only a very small segment of people interested in the matter, and it definitely discriminates against the use of an important commodity—reclaimed rubber. Grade A camelback should contain no reclaimed rubber, if natural rubber is used. With synthetic rubber, 10% reclaimed rubber by volume could be included.

The basis for the specification is asked, and the fact that the technical committees of The Rubber Manufacturers Association, Inc., and the Rubber Reclaimers Association were not contacted is underscored.

Trimble states that he objects to government intereference in the production of material, by people who obviously have not considered the matter very carefully.

"I am unalterably opposed to 'compounding by law,'" he said. "This should be left to industrial chemists—not to government agencies. . . .

"If your agency is interested in standardization and in giving the general public the best value in retreaded tires, it would be well to call a representative technical group together who know the problem and then let them carry on without government sponsorship or interference," he added.

"The standard for which your agency is trying to gain acceptance not only limits the use of reclaimed rubber, but leaves the door wide open for making very poor types of tire retreading material, the very thing it is trying to defeat."

The Reclaimers Association president said that he felt sure that the Association and others would protest as vigorously as possible adoption of this Commerce Department standard.

URWA Opens 1954 Wage Talks

The first wage talks between the United Rubber Workers of America, C.I.O., and the rubber industry are scheduled to begin in Canton, Ohio, on May 4. Goodyear Tire & Rubber Co. has been asked to sit down with union representatives and discuss a "substantial" general wage increase. The Goodyear contract runs until February 10, 1955, but provides for wage reopening by either company or union on notice.

In Canada the URWA announced in mid-April that it had decided to seek a 15¢-an-hour general wage increase and a guaranteed annual wage in this year's contract negotiations. In addition, it was indicated that the Canadian local unions would ask pension improvements, adjustments of wage inequities, and fringe benefits.

A strike of more than two weeks' duration at Bearfoot Sole Co., Inc., Wadsworth, O., was settled April 11. A new contract agreed to by the company, but awaiting ratification by the union, leaves wage rates the same as before the strike, but either side may open the wage question for further consideration after October 31, 1954, on 60 days' notice. The contract runs until October 31, 1955. The company agreed to reinstate the health and life insurance programs on the same basis as before the strike and agreed to two weeks' paid vacation after three years' service, instead of five years.

VALUE OF RUBBER GOODS MANUFACTURERS' SALES

(Adjusted for Seasonal Variations; Millions of Dollars)

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
424	435	473	444	422	436	448	409	416	395	346	369

BOOK VALUE OF MANUFACTURERS' INVENTORIES

(Seasonally Adjusted; Millions of Dollars)

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
866	868	880	874	888	914	925	897	908	881	867	868

Other Industry News

Bakelite Producing Fluorothene Resins

The commercial production of Bakelite fluorothene resins at a new continuous process plant in South Charleston, W. Va., has been announced by Bakelite Co., Division of Union Carbide & Carbon Corp., New York, N. Y. The plant is being operated by Carbide & Carbon Chemicals Co., another division of Union Carbide, but sales of the resins will be handled by Bakelite.

The culmination of five years of process development, the continuous manufacturing process is said to assure greater uniformity of material than is possible with batch methods. Technically a polymer of chlorotrifluoroethylene, Bakelite fluorothene is a specialty-type plastic exhibiting excellent toughness, heat resistance, volume resistivity at room and extremely high temperatures, and resistance to the most corrosive chemicals.

Three high molecular weight resins, designated as Bakelite fluorothene FYTD, FYTH, and FYTS, are available in both pelletized and granulated forms. These resins are graded according to their melt viscosities at 446° F., which are 5, 15, and 50 megapoises, respectively. A large part of the plant's initial production is being absorbed by the military, with the balance being used in the electrical and chemical industries.

New Uskon Distributors

The appointment of seven new distributors to handle sales of Uskon conductive rubber radiant-heating panels in Pennsylvania, New York, New Jersey, and California has been announced by United States Rubber Co., New York, N. Y. Under terms of the franchises, the distributors are authorized to name local electrical dealers to sell and install the panels, which were formerly available only on a limited scale. The new distributors are North Bay Electric Works, Inc., San Rafael, Calif.; Atlantic Electrical Distributors, Inc., Hackensack, N. J.; Kahant Electric Supply Co., Dover, N. J.; Rale Electric Co., Asbury Park, N. J.; Quigley-Lockrey Associates, Philadelphia, Pa.; Scott Electric Co., Greensburg, Pa.; and Upstate Radiant Heat, Inc., Syracuse, N. Y.

Drake Division Head

William P. Drake, formerly vice president of the company, has been named president of the new industrial chemicals division of Pennsylvania Salt Mfg. Co., Philadelphia, Pa. In his new capacity, Mr. Drake is responsible for both the manufacture and the sale of Pennsalt's industrial chemicals. He joined the company in 1934 and subsequently rose through the posts of salesman, sales supervisor, product sales manager, and general sales manager, having been elected vice president of the firm in 1949. He served the government for six months in 1952 as director of the Rubber, Chemicals & Drug Division, Office of Price Stabilization, and is presently director of the Chlorine Institute, Inc., and of Main Belting Co.

Phillips Constructing Polyethylene Plant

A semi-commercial plant which will manufacture a newly developed, reportedly superior type of polyethylene plastic is being constructed on the Houston Ship Channel in Texas by Phillips Petroleum Co., Bartlesville, Okla. The process for making the new polymer, designated Marlex 50, is said to be unique in that it requires a substantially lower investment than existing methods since operating pressures are of the order of 500 psi. compared to the extreme pressure of 15,000-30,000 psi. now required at commercial polyethylene installations.

After samples of the plastic manufactured at the new facility are investigated by fabricators, the company anticipates constructing a larger plant to accommodate the demand.

Not to be confused with Marlex 20, a polyethylene material intended for use only as a modifier for existing polyethylenes and waxes, the new material is completely different from the modifier and is recommended for use by itself. It is reported by Phillips to have several qualities which are very superior to existing polyethylene, among which is resistance to steam sterilization. In addition, the company contends that the material will permit the manufacture of lighter, stronger, and tougher articles that are greatly resistant to heat and to water vapor penetration than can be made of presently available polyethylene.

Goodyear TV Playhouse Receives Award

The George Foster Peabody Award, one of the top honors for television shows, has been given to Goodyear TV Playhouse for outstanding entertainment in 1953. Citing the consistently fine programs of the Goodyear-Philco Television Playhouse, the award paid special tribute to the producer, Fred Coe, "for his firm emphasis on good writing" in presenting the dramatic program during last year.

New Naugatop Patterns

Two new patterns of Naugatop plastic topping material have been introduced by United States Rubber Co., New York, N. Y. The new patterns are Grass and Pebble, making a total of four in the line. The Grass pattern is available in aqua, turquoise, sun-tan, and olive colors; while the Pebble design comes in mist green, lemon, sand, and charcoal.

Designed for application by the home owner, the plastic top covering comes with adhesive on its gluing surface for attachment to plywood, hard board, or metal surfaces to modernize table tops, sink tops, bars, cabinets, and other flat surfaces. The covering has a satin finish, is easily cleaned with a damp cloth, is unaffected by soap and grease, and is resistant to fruit acids, burning cigarettes, alcohol, and boiling water, it is further claimed. The material is made in 30-inch widths and sold through lumber dealers, hardware stores, floor covering stores, and department stores.

American Hard Rubber Merges Divisions

The chemical equipment division and the plastics division of American Hard Rubber Co., New York, N. Y., have been merged into one unit which is responsible for the combined hard rubber and plastics operations. In charge of the new organization is George H. Reed, formerly manager of the plasics division.

The company made this change with the belief that the line between hard rubber and plastics is practically non-existent and that both materials must be grouped in one class when substances for corrosion-resistant piping, tank lining, etc., are considered. In fact, many of the new products developed by the company are rubber-plastic combinations.

Mr. Reed, who joined the firm in 1934, has had wide experience in the field. After three years of service in laboratory and manufacturing operations, he became a field engineer for the chemical equipment division and was subsequently transferred to the plastics division in 1947. He holds membership in the thermoplastic pipe and thermoplastic structures divisions of the Society of Plastics Industry, in the Society of Plastic Engineers, and in the American Ordnance Association.

Goodyear Flooring Distributor

Akron Rubber Co., with offices and warehouses in New York, N. Y., and Newark, N. J., has been appointed by Goodyear Tire & Rubber Co., Akron, O., as a distributor for rubber and vinyl flooring in the metropolitan New York area. Akron Rubber is dicontinuing its flooring contracting operations and will concentrate on the distribution of Goodyear flooring and industrial products.

Lack Carpet Co., one of the earliest Goodyear distributors, will continue to serve the same area.

U. S. Lifewalls in Truck Tires

The U. S. Royal heavy-service nylon Lifewall, previously available for passenger cars only, has been introduced in the light truck field by United States Rubber Co., Rockefeller Center, New York 20, N. Y.

Intended for use particularly with trucks on scheduled delivery service, the Lifewall is an air container made of two plies of nylon. When placed in a conventional four-ply tire, the unit is reported to double the rupture resistance of the tire.

Four small truck sizes of the units are offered: 6.00 x 16; 6.50 x 16; 7.00 x 15; and 7.50 x 16.

Turner in New Post

George T. Turner has been appointed technical director of I. B. Kleinert Rubber Co., College Point, N. Y., in charge of the firm's laboratory and research. He has wide experience in the field of rubber technology and has been with Kleinert since 1946.

General Tire Mergers Approved; Officers Reelected

Stockholders of The General Tire & Rubber Co., Akron, O., at the recent annual stockholders' meeting approved the mergers of Textileather Corp., Toledo, O., and Bolta Corp., Lawrence, Mass., into General. Expected to have become effective with the filing of the necessary legal papers on April 30, the mergers establish General as the largest manufacturer of vinyl sheeting and film in the world.

All directors and officers of the company, headed by William O'Neal, president, were reelected at the meeting. The other officers are M. G. O'Neil, executive assistant to the president; L. A. McQueen, C. J. Jahant, C. F. and T. F. O'Neil, D. A. Kimball, H. A. Bellows, H. M. Dodge, and J. E. Powers, vice presidents; T. S. Clark, treasurer; F. W. Knowlton, secretary; C. A. Hill and James Little, assistant treasurers; and J. L. Wade, assistant secretary.

In addition to C. F. and T. F. O'Neil, Jahant, McQueen, Knowlton, and Kimball, the following were reelected as directors: W. E. Fouse, R. Iredell, S. S. Poor, E. W. Ross, N. F. Creamer, and B. E. Smith.

Saflex Production Increased

The completion of a 50% expansion in the production of Saflex vinyl butyral, a product widely used in the manufacture of laminated safety glass, has been announced by Monsanto Chemical Co., Springfield, Mass. This is the second production increase in less than one year; the first occurred in mid-1953 with an expansion of 20%. In addition to the increased quantity now produced, the company will be able to supply a more diversified product, including a heavier-gage material.

At the same time, Monsanto reported that Shawinigan Resins Corp., of Springfield, an associated company and the supplier of Saflex raw material, Butvar resin, has increased its production by a similar amount.

High-Strength Conveyor Belt

One of the world's strongest conveyor belts, designed to operate at a working tension of 120,000 pounds, is to be built by Goodyear Tire & Rubber Co., Akron, O., for use in a mining operation in northern Minnesota. The 60-inch wide, steel cable belt will haul low-grade ore at a maximum tonnage of 3,360 tons an hour and a speed of 395 feet a minute. The belt will carry ore 1,000 feet on a line, with a lift of 280 feet. Construction of the belt will require 48,000 pounds of specially compounded rubber, 7,000 square yards of fabric for plies, and 85 miles of high-tensile steel cable.

General Presents Sports Show

Dealers of The General Tire & Rubber Co., Akron, O., have begun sponsoring a series of radio and television programs entitled, "General Sports Time with Harry Wismer," over the facilities of the Mutual Broadcasting System. The sportscasts, said to be the largest single sports presentation on radio and television, are aired on Sunday evenings from 6:45 to 7:00 p.m., EST.

Snell Inaugurates "On-Approval" Rubber Compounds

A new system for purchasing rubber compounds on approval has been introduced by Foster D. Snell, Inc., 29 W. 15th St., New York 11, N. Y. According to the company, receipt of an order for a particular type of elastomer or plastic compound intended for a specific application will be answered by a description of the pertinent properties of the material and by a laboratory batch of the compound. The batch is sent on approval; if acceptable, the formula and its processing directions may be purchased. If not acceptable as such, but judged to show promise for the application, Snell will undertake the necessary development work on a job or retainer basis.

International Shoe's Rubber Processing Plant

Operation of the newly constructed rubber processing plant at Bryan, Tex., was begun recently by International Shoe Co., St. Louis, Mo. Peak production from the unit, such production to include molded and slab composition soling and heeling materials for premium-grade and novelty footwear, will demand between 75-85 long tons of crude rubber a month. Manufacturing facilities at the plant are in a one-story structure covering 70,000 square feet of floor space and will employ some 200 men and women when full capacity production is achieved.

Hewitt-Robins Finances Fremont Purchase

The direct private placement of $1,250,000 of 5¼% cumulative preferred stock, $50 par value, with a financial institution has been announced by Hewitt-Robins, Inc., Stamford, Conn. The company intends to use the new money in connection with the purchase of the assets and business of the Fremont Rubber Co., Fremont, O.[1] Transfer of Fremont's ownership was slated to occur a few days after the April 1 announcement.

[1] See our Apr., 1954, issue, p. 83.

Harwick Standard Changes Boston Address

The new address of Harwick Standard Chemical Co. of Massachusetts is 661 Boylston St., Boston 16, Mass. The firm had previously been located at 404 Chamber of Commerce Bldg. in Boston.

Asphalt Production Increased

A one-third increase in the output of the Perth Amboy, N. J., asphalt plant has been announced by Witco Chemical Co., 260 Madison Ave., New York 16, N. Y. This increase has been accomplished by the addition of a 60- by 100-foot section to the cooling and shipping shed of the facility wherein hot liquid asphalt is solidified in shipping containers. Cost of the new fireproofed structure is placed at $15,000.

New Furnace for Seamless Tubing by Timken

A continuous annealing furnace, designed to produce heavy-walled seamless tubing at a rate of 3,000 tons a month, will be erected at the Gambrinus plant of The Timken Roller Bearing Co., Canton, O., at an estimated cost of $278,000. Increased demand for the tubing by the oil industry was given as the reason for this expansion of existing production facilities, according to a company spokesman, although use of this tubing as a replacement for comparable forged parts and in the automatic transmission field has been suggested.

Slated for completion in early fall, the new furnace will measure 175 feet in length and 6⅔ feet in width. It will be gas fired, charged and discharged by a fork lift truck, and housed in a 300- by 24-foot structure. Controls for heating and cooling of the steel will be the most modern possible, the company states.

Sales Changes at Manco

The realinement of sales territories and the assignment of new responsibilities to Joseph P. Healey, vice president and sales manager, has been made public by Manco Products, Inc., Melvindale, Mich. Mr. Healey, who maintains company sales headquarters in Buffalo, N. Y., is now also responsible for the sales territory which encompasses metropolitan New York, New York State, northern New Jersey, and some parts of southern Connecticut. The company expects that, as a result of these changes, closer service and greater technical assistance to users of its "Tru-Cast" beryllium copper mold components will be possible.

Double Eagle Tire Improved

The 1954 version of the all-nylon Double Eagle tire, made by Goodyear Tire & Rubber Co., Akron, O., embodies further improvements by the use of prestretched nylon cord for maximum resiliency and strength, and a quieter, longer wearing, smoother riding tread. More protection against skids is provided by a new diamond pattern tread, and tiny ridges placed between the outer ribs of the tire minimize squeal and other road noises. The size of the design elements in the tread is varied to reduce noise further and to improve traction. Available in most popular sizes, the tire is made with white sidewalls and a scuff rib to protect against curb scraping.

New Elastic Naugahyde Design

A new two-toned design, Contemporary, is being produced in Elastic Naugahyde plastic upholstery by United States Rubber Co., New York, N. Y. Made possible by the installation of new embossing equipment in the company's Mishawaka, Ind., plant, the new design is being made in black with white embossing, white with silver embossing, and in gold antique, silver antique, light chartreuse, sand, blue spruce, lemon peel, dove gray, mustard, persimmon, and green olive colors. Contemporary is available in rolls 52 inches wide and weighs 38 ounces per linear yard.

Goodrich Steel Cable Conveyor Belt

The first trial run of a conveyor belt reinforced with high-tensile steel cables took place recently as part of the operation of Pennsylvania Railroad's new $10,000,000 ore pier in the Delaware River at Greenwich Point, Philadelphia. Constructed by The B. F. Goodrich Co., Akron, O., especially for this purpose, the belt is 54 inches wide and extends some 1,600 feet from a ship-unloading crane to railcar-feeding hoppers.

A two-belt system now installed permits two ore ships to be unloaded at a total rate of 3,600 tons an hour. Future plans for expansion of the pier call for the belt system to handle four ships simultaneously at a rate of 10,800 tons an hour.

Splicing of the belt required the use of a new, patented method developed by the manufacturer. The cable ends were first cut in a staggered pattern, and small tubular connectors were placed over the butted ends. After a light crimping, the partially made splice was stressed to even the lengths of the cables. The connectors were then given a final crimping to lock them to the cables, and the rubber and fabric which had been removed for the operation were rebuilt around the cables. Vulcanization of the splice completed the installation.

Materials Conference Hears Talks on Rubber and Plastics

Featured among the papers delivered at the second Basic Materials Conference were three interesting addresses: "Rubber," J. H. Faull, Jr., United States Department of Navy; "Plastics," Jesse H. Day, editor of *SPE Journal;* and "Adhesive Bonding of Metals and Plastics," George Epstein, North American Aviation, Inc. The Conference, scheduled for the International Amphitheatre in Chicago, Ill., from May 17-20, runs concurrently with the Basic Materials Exposition.

Some 10,000 executives and engineers were expected to attend the conference sessions, at which 17 specialists delivered talks that emphasized the relation of materials to one another. General chairman of the meetings and opening speaker was T. C. Du Mond, editor, *Materials & Methods.*

Elections at Eagle-Picher

Recent elections at The Eagle-Picher Co., Cincinnati, O., have resulted in the naming of two new vice presidents and a new secretary.

Orson A. Rockwell, formerly vice president of Calumet & Hecla, Inc., was elected vice president and director of Eagle-Picher and was named general manager of the mining and smelting division. Glen J. Christner, general manager of the insulation division, was elected vice president. Richard Serviss, formerly assistant secretary, was promoted to the post of secretary.

Reelected as directors and officers of the company were: Joel M. Bowlby, chairman of the board; T. Spencer Shore, president; William R. Dice, vice president and comptroller; Carl A. Geist, vice president and treasurer; and Hermon F. Stafford and Miles M. Zoller, vice president. Carl F. Hertenstein, Stanley R. Miller, John J. Rowe, and William H. Mitchell were reelected directors; and K. E. Kimmel and John H. Winchester were reelected assisant secretaries.

Timken Uses Vibration Detector for Machines

An instrument which can find abnormal vibrations in a machine without the necessity of dismantling is being used by The Timken Roller Bearing Co., Canton 6, O. A portable device, the Vibratron consists of a vibration pick-up, a filtering probe, a stroboscopic lamp, and an electronic instrument that records frequency and amplitude of vibration.

Timken uses the device on its grinding wheels, which must be very accurate in view of the requirements of finished roller bearings. As a maintenance tool, the Vibratron has reportedly been able to maintain an average vibration level on these grinding units to 0.000090-inch. The necessity of controlling vibration to this extent can be readily appreciated when it is realized that tolerances as low as 0.000075-inch are required on the bearings.

In operation, the probe of the instrument is placed on the spindle, bearing, or housing of a machine that is shut down. Readings are taken to find how much vibration is transmitted to the machine from other machines on the same floor. Then, the various parts of the machine are started, one at a time, to find the amount of vibration caused by each part. When an unbalanced part is discovered, the lamp is used as a double check to insure that the suspected part is causing the greatest vibration of any in the machine. Repair or replacement of the guilty part is then performed until the level of the vibration of the operating machine approaches the vibration reading obtained when the machine was idle.

RFC's Freight Policy Changed for Export Shipments

The uniform freight charge policy of the Reconstruction Finance Corp. is no longer applicable to GR-S synthetic rubber that is destined for export, according to a recent announcement from the corporation. From now on, export shipments of GR-S will be sold on an f.o.b. producing plant or warehouse basis.

Another change in the shipping procedure for such rubber is that export shipments to be carried as ocean freight will be packaged in a burlap bag at no extra charge to the purchaser. This covering will be in addition to the usual multiwall paper bag previously employed.

Reason for these changes, which will not affect RFC's domestic freight policy, is that current large inventories will permit the shipment of most types of synthetic rubber from plants located in the Gulf of Mexico area.

Award to Most Improved Basketball Team

Special trophies, awarded to "The Most Improved College Basketball Team in the Country," have been won for the 1953-1954 season by the College of Steubenville, Steubenville, O. The trophies annually presented by United States Rubber Co., New York, N. Y., are based on the Dick Dunkel Basketball Rating System, which this year rated and ranked 793 college teams in the United States, Canada, Hawaii, and Mexico. Established by the rubber company in 1950, the awards have been given in the past to Fordham University, Clarion State College, Furman University, and Rio Grande College in that order.

Cross-Cutting and Regrooving Tire Tread Machine

A machine that cross-cuts and regrooves a standard tire in 4½ minutes has been developed by The B. F. Goodrich Co., Akron, O. End-result of this treatment is a tire which has the tread design similar to that of the company's Life-Saver tubeless tire.

New and recapped tires as well as somewhat worn tires can be handled by the machine. An infinite number of spacings and depths can be set on the unit, according to the company, although a basic cross-cutting pattern has been developed to provide positive skid protection of the kind available with the tread's prototype.

The Life-Saver tire features a tread having more than 10,000 blocks of rubber, 1/16-inch square, and ¼-inch deep. It is claimed to perform very well on ice, giving up to 114% increased traction when starting and up to 30% more gripping power when stopping as compared to ordinary tires. Figures given on its performance on wet pavements and on snow also show the superiority of this tread over conventional designs.

The machines are currently in production, and many have already been delivered to company dealers and retail stores.

New Muehlstein Laboratory Opened

The newly built research, testing, and quality control laboratory of H. Muehlstein & Co., Inc., 60 E. 42nd St., New York 17, N. Y., located at the company's Jersey City, N. J., plant, has been officially opened. As the largest of the firm's three laboratories, this facility will conduct its own research and, in addition, will examine and test the findings of the other two labs. The new laboratory is completely equipped with the necessary machines and instruments to conduct investigations in the rubber and plastics fields, including problems encountered by customers in factory operation and processing.

Armstrong Shipments from New Haven

Helping to inaugurate regular general cargo service from the recently reopened port at New Haven, Conn., Armstrong Rubber Co., of that city, recently shipped 2,000 heavy-duty Norwalk brand tires to Formosa via the *Flying Enterprise II.*

Food and Drug Antioxidant

Ionol-CP, chemically identified at 2,6-ditert-butyl-4 methylphenol, has been developed by Shell Chemical Corp., New York, N. Y., for use as an antioxidant in food and drugs in compliance with the toxicity requirements of the Food & Drug Administration of the Federal government. Also known as butylated hydroxy toluene, the new material has been the subject of an extensive test program designed to determine the safety of the product for human and animal consumption.

Shell claims that the antioxidant, besides effectively preventing rancidification of fats and shortenings and destruction of certain vitamins by air, can be used to stabilize rubber and plastic compositions that are used in food handling equipment.

Diamond Alkali Elects

Raymond F. Evans, former president, was elected chairman of the board, and John A. Sargent, previously the executive vice president, was named president of Diamond Alkali Co., 300 Union Commerce Bldg., Cleveland 14, O., at a meeting of the firm's directors on April 13, following the annual stockholders' meeting. All other officers were reelected, as were the 10 directors.

As board chairman, Mr. Evans will continue to function as chief executive officer of the company and will be concerned especially with long-range planning and policy making.

Mr. Sargent, as president, will direct the general management of the company's activities.

The post of executive vice president will not be filled at this time.

With Diamond Alkali since 1931, Mr. Evans has served as a production worker, research worker, organizer and president of Diamond Magnesium Co., vice president and general manager of the firm's Painesville, O., plant, executive vice president, and president.

Mr. Sargent joined the company as treasurer in 1946, became vice president—finance in 1947, and was elected executive vice president in 1948.

New Tire Retreading Plants

Four new tire retreading plants, designed especially for the servicing of large off-the-road tires, have been opened by Goodyear Tire & Rubber Co. Said to be the largest of their type in the nation, the new plants are located in Philadelphia, Denver, Spokane, and Los Angeles. Each plant has recapping molds capable of accommodating tires as large as 30.00-33 and weighing more than a ton, and repair molds capable of handling tires up through the 30.00 size.

Since the average tire recapper is not equipped for this type of work, the new facilities are expected to be especially valuable to contractors and others engaged in big earthmoving projects. The retread plants will also specialize in recapping and repairing all popular truck and auto tire sizes. Tractor tire retreading by the Vacu-Lug process, by which worn lugs can be replaced, is another of the services offered by the plants. The Denver and Philadelphia plants recently observed their formal openings; while the Spokane and Los Angeles plants have been in operation for a longer period.

BWH Wins Safety Award

For working 1,534,811 man-hours without a lost-time accident, the employes of Boston Woven Hose & Rubber Co., Cambridge, Mass., were recently presented with a plaque from the Liberty Mutual Co. The award also recognized the reduction in lost-time accidents (almost 500%) achieved by BWH for 1953.

Koroseal Distributor Named

Samuel Moore & Co., Mantua, O., has been named national distributor to the replacement trade of Koroseal bus and transportation upholstery materials made by B. F. Goodrich Co. Industrial Products Division.

Health Program at du Pont

An industrial medicine program that goes far beyond periodic employe medical examinations and even protection of people in the manufacture, use, and transportation of chemical products is being conducted by E. I. du Pont de Nemours & Co., Inc., Wilmington, Del. Involved in the work of company's health staff are investigations in such diverse areas as fatigue, heart disease, clothing comfort, and new therapies and techniques for meeting people's physical and psychological needs.

Key point in the program, and the point from which much of health services originates, is the Haskell Laboratory for Toxicology & Industrial Medicine with its new, recently dedicated medical laboratory near Newark, Del. The Haskell organization, in addition to investigating how safe various chemicals are for public consumption, also teams up with the company's medical division, its physicians, and its engineers to find answers to problems of safety and health in the design and operation of plants and equipment, the manufacture of chemical containers, etc.

Disease prevention is another aspect of the program, according to the recently published du Pont booklet, "Protecting the Public Health." The program does not stop even at this point since some 92% of the company's products goes to other manufacturers for further processing. This practice requires the medical research to follow into those plants of the customer to determine how further processing of the products will affect the safety of both the customer's employes and the public consumer.

BFG Gasket Plant in Indiana

Manufacturing operations in a Salem, Ind., plant, formerly occupied by Ric-Wil Co., have been started by The B. F. Goodrich Co., Akron, O. The plant will employ about 150 workers and will produce gaskets used principally in refrigerator manufacturing. The building, completed in 1952, is of brick and steel construction, has 28,500 square feet of floor space, and is situated on a 44-acre tract. The plant will be operated by Goodrich's industrial products division and represents the company's first manufacturing operation in Indiana.

Hardesty Moves Offices

W. C. Hardesty Co., Inc., moved its main offices on April 26 to new and larger quarters at 25 Main St., Belleville 9, N. J. According to F. G. Merkel, company president, the move was in line with the current expansion of the firm's research facilities, sales staff, and production program. Hardesty, which is observing its twenty-eighth year in the fatty acid and chemicals fields, was previously quartered at 41 E. 42nd St., New York, N. Y.

New Rubber Roll Plant

Stowe-Woodward, Inc., Newton Upper Falls, Mass., has announced that a second branch plant at Neenah, Wis., is to start production early in May of rubber covered rolls for use in the paper, paper converting, textile finishing, tanning, and other industries. The rolls will be made in sizes from a few inches to several feet in diameter and up to more than 26 feet in length.

Pennsalt Forms New Divisions

Two new operating divisions, the industrial chemicals and the chemical specialties divisions, have been formed by Pennsylvania Salt Mfg. Co., Philadelphia, Pa. Purpose of this realinement, which completes the company's decentralized organizational structure, is to provide a more logical product grouping, better customer service, and a suitable pattern of organization for expected future growth, according to an announcement publicizing these changes.

Change-over from the existing organization is expected to require approximately one year, with the affected positions at the top and middle management levels. The result will be the independence as far as manufacture and sale of respective products are concerned of both divisions.

Personnel involved in the new set-up are William P. Drake, company vice president in charge of sales, who has been named president of the industrial chemicals organization; Albert H. Clem, general sales manager, who becomes president of the chemical specialties division; and William F. Mitchell, formerly head of Pennsalt's manufacturing activities, who becomes vice president in charge of engineering, purchasing, and traffic of the consolidated company.

Chemical Tanker in Service

The recently launched *S. S. Marine Dow-Chem,* the first large-capacity tanker built in the United States for carrying liquid chemicals in bulk, sailed from the Dow Chemical Co. dock at Freeport, Tex., on her maiden payload voyage.

The tanker has six tanks, each 15 feet in diameter and 41 feet deep, designed for interchangeable transport of hydrochloric acid and caustic solution. These tanks are lined with a specially compounded rubber developed by Goodyear Tire & Rubber Co. and have a total capacity of about 240,000 gallons. Some 35,000 pounds of rubber were consumed in lining the tanks and connecting piping.

Similar linings are being applied by a Goodyear field crew to two storage tanks at Newark, N. J., to receive the chemicals from the *Dow-Chem's* forward tanks. These storage tanks measure 39 feet in diameter and 54 feet high.

Foxboro's Dallas Plant Ready

A new branch factory of The Foxboro Co., Foxboro, Mass., constructed of brick on a single-story plan, was scheduled for completion by April 30. Located in Dallas, Tex., the factory will provide 13,000 square feet of space for increased instrument manufacturing activities, service, and repair, and centralized warehousing of instruments and control valves. The structure will also house enlarged sales offices for the Dallas branch, which has been serving the South and Southwest for the past 20 years.

Consolidates Offices

Tempil® Corp. has consolidated all its facilities, including offices and shipping, at 132 W. 22nd St., New York, N. Y. Formerly only the firm's plant and laboratory were located at this site. The move, effective May 1, provides the additional space needed by the company to meet its growing business requirements.

"Speedwalk" Being Installed

A "Speedwalk" passenger conveyor belt designed by Goodyear Tire & Rubber Co. and Stephens-Adamson Mfg. Co. is being installed by the Hudson & Manhattan Railroad Co. in its Jersey City, N. J., terminal. Expected to be in operation in mid-May, the belt will carry up to 10,800 riders an hour from the H & M station mezzanine to the neighboring Erie Railroad station. The belt conveyor is 5½ feet wide and 227 feet long, of which 137 feet are on a 10% grade. The conveyor is reversible to operate in opposite directions in accordance with commuter traffic flow. Belt speed will be 120 feet a minute, with push-button control, but can be varied to meet requirements. The Goodyear-made belt is of fabric and rubber construction, 5/8-inch thick, 460 feet in length, and weighs almost 11,000 pounds. After installation, the belt will be spliced by a portable vulcanizer to form a continuous length.

Rug Underlay News

A new sponge rubber underlay for carpets, designated U. S. Rug Underlay Airwave, has been introduced by United States Rubber Co., Rockefeller Center, New York 20, N. Y. Designed for volume selling to retail accounts, the underlay is ¼-inch thick and 53 inches wide and is said to be luxurious in feel, permanently resilient, and easy to lay and clean.

The company also announced a new nine-foot width in waffle sponge rug underlay. This width comes in 60-foot rolls and is sold and stocked by U. S. Rubber's branch sales organization. Simultaneously, a reduction of 45¢ a square yard was announced in the suggested retail price of 54-inch wide waffle rug underlay.

Hobbs Opens NYC Office

Hobbs Mfg. Co., Worcester, Mass., manufacturer of converting machinery, has opened a branch sales office at 132 Nassau St., New York, N. Y. Sales and services in this office are under the direction of George B. Clay, who has been associated with the firm for 10 years. In addition to sales work Mr. Clay has had experience in the production and supervisory fields and has contributed to the development of Hobbs machines.

Products being handled from the New York office include Autotronic, "Adjustable Die," and Tri-Power presses; production, corner, and Strong label cutters; power and Jacques hand shears; slitters and rewinders; and Alquist winders.

Geon Plastic Shoe Covers

Canvas shoe covers coated with Geon vinyl paste resin, a product of B. F. Goodrich Chemical Co., are being used at one of the Oak Ridge, Tenn., atomic plants to minimize the spread of contamination by radioactive materials. Resembling the long flapper-type shoes worn by circus clowns, the protective devices are slipped over the workers' shoes prior to their entering a contaminated area and are removed when the workers exit from the area. The coating, applied by Flexible Products Co., Marietta, Ga., provides a tough, flexible, abrasion resistant surface to the soles of the canvas covers.

Monsanto Officers Reelected

All officers of Monsanto Chemical Co., St. Louis, Mo., were reelected at a meeting of the directors on April 8. Reelected were Edgar M. Queeny, board chairman; Charles A. Thomas, president; Robert R. Cole, executive vice president; R. L. Brandenburger, J. L. Christian, F. J. Curtis, John L. Gillis, C. A. Hochwalt, R. K. Mueller, E. A. O'Neal, Jr., C. H. Sommer, Jr., F. N. Williams, and J. R. Wilson, vice presidents; D. M. Sheehan, vice president and comptroller; W. W. Schneider, vice president and treasurer; E. J. Putzell, Jr., secretary; E. J. Cunningham, J. W. Ludwig, W. I. Warren, and E. J. Wipfler, assistant comptrollers; J. F. Martin, J. R. Matlock, R. H. Stocke, and E. D. Toland, Jr., assistant treasurers; and C. E. Caspari, Jr., assistant secretary.

Monsanto-I.G. Firm Announced

Monsanto has joined with Farbenfabriken Bayer Aktiengesellschaft, of Leverkusen, Germany, in setting up a jointly owned company in this country for the production of isocyanate chemicals. According to J. R. Wilson, Monsanto vice president and general manager of the research and engineering division, the new company is expected to play a prominent role in the isocyanate chemical field. Isocyanates are used to produce rigid and flexible porous plastics, synthetic rubber, fibers, adhesives, and chemical intermediates. No decision has been made as to the location of the isocyanate plant, Wilson said.

Departments Consolidated

First Machinery Corp., through Fred R. Firstenberg, president, has announced the consolidation of all its departments under one roof at 209-289 Tenth St., Brooklyn, N. Y. The move brings the executive offices, warehouse stock, rebuilding shops, and engineering and fabrication departments together into a centrally located facility occupying an entire city block. The firm's offices were previously at 157 Hudson St., New York, N. Y.

Increased Availability of Emery Plasticizers

The Plastolein plasticizers manufactured by Emery Industries, Inc., Carew Towers, Cincinnati, O., are now available in increased quantities as a result of the company's new ozone-oxidation plant. The most popular of the materials, Plastolein 9058 DOZ (di-2-ethylhexyl azelate) and 9057 DIOZ (di-iso-octyl azelate), have found wide acceptance in all types of vinyl products because of their excellent low-temperature performance characteristics.

California Sales Representative for Vulcan

West American Sales Co., Los Angeles, Calif., has been appointed California representative of several of the major products of Vulcan Rubber Products Co., a subsidiary of Reeves Bros., Inc., New York, N. Y. Paul Sampsell, Jr., president of the sales company, will handle Vulcan's line of gas meter diaphragms, industrial coated fabrics, and nylon-neoprene fabric.

New Railroad Tieplate

A new rubber-metal railroad tieplate, said to cushion shock, give smooth rides, and reduce maintenance costs by as much as 20%, has been announced by the recently formed American Railroad Pad Co. According to A. H. Philpot, executive vice president of the firm and inventor of the device, the tieplate consists of a synthetic rubber base, a steel or aluminum core, and a synthetic rubber rail cup on top, with all three components bonded together under a pressure of 35 tons per square inch. Instead of previous methods which employ separate pads between tie and plate and rail and plate, the new product provides a single unit that can be attached to the ties with standard spikes.

The synthetic rubber compound used is claimed to provide extreme toughness, durability, and resiliency; be unaffected by temperatures from —60 to +900° F.; be impervious to oil, grease, and salt water; and have been proved in engine mountings for jet planes.

Jet Braking Device Licensed

A licensing agreement to manufacture a jet thrust-reverser device has been completed by Aerojet-General Corp., Azusa, Calif., with the patent holder, Societe Nationale d'Etudes et de Construction de Moteurs d'Aviation, a French aviation engine firm. According to Dan A. Kimball, Aerojet president, the thrust-reverser device applies an aerodynamic principle to jet braking and is much more efficient than the mechanical braking methods tried to date. An accessory that can be fitted to any turbo-jet engine, the device uses an air blast piped in from the plane's compressor to divert the jet flow into annular baffles which complete the reversing action. Of value in permitting landings on limited runways, the thrust-reverser provides a companion product to Aerojet's JATO unit which permits safe take-offs from such runways.

New Site for Brooklyn Poly

Polytechnic Institute of Brooklyn has contracted to purchase the eight-story, block-long plant building of American Safety Razor Corp. in Jay Street in downtown Brooklyn, N. Y. The acquisition of the building, at an announced price of $2,000,000, will enable the Institute to bring its widely dispersed facilities together in one suitable modern structure.

An additional $1,500,000 will be required to adapt the plant to educational purposes and to purchase adjacent properties as sites for a proposed new library and student lounge. The date when the Institute will move into the new quarters is still undetermined, being dependent on many factors including the success of a fund-raising campaign.

Firestone Receives Award

Firestone Tire & Rubber Co., Akron, O., for the third time in four years has been given a "Certificate of Outstanding Public Relations Achievement" award, for 1953, by the American Public Relations Association. The award, presented during the Association's tenth annual convention in New York, N. Y., was given to Firestone for its employe safety information program.

NEWS ABOUT PEOPLE

H. J. Osterhof

H. J. Osterhof, director of research for Goodyear Tire & Rubber Co., Akron, O., has been appointed a member of the Materials Advisory Board, which acts in an advisory capacity in the field of research to the United States Department of Defense. For the past two years, prior to the recent reorganization of the Defense Department, Dr. Osterhof was chairman of the panel on high polymers for the Committee of Materials, Research & Development Board. A member of Goodyear's research department since 1929, Dr. Osterhof became head of synthetic rubber and physical chemistry research in 1941, and took over his present duties in 1950.

George E. Field has been named manager of the Marietta, O., plant of the B. F. Goodrich Co. Industrial Products Division, succeeding **Robert Price,** who resigned. Field joined Goodrich in 1942 as production manager and later became plant manager of the GR-S plant in Louisville, Ky. He was transferred to Cleveland in 1947 as technical manager and coordinator of all Goodrich operated GR-S plants, and in 1952 he was made field sales manager of B. F. Goodrich Chemical Co.'s plastic materials sales department. Field served on the Rubber Reserve operating committee and the subcommittees on process improvement, plant revisions, and test methods.

Karl S. Hay has been named manager of general accounting for the industrial products division, The B. F. Goodrich Co., Akron, O. Mr. Hay, a Goodrich employe since 1930, had previously been plant auditor for American Anode, Inc., now a part of the industrial products division.

James R. Turnbull, assistant general sales manager for the plastics division of Monsanto Chemical Co., Springfield, Mass., has been appointed a member of the five-man survey team to study the Fish & Wildlife Service of the United States Department of the Interior and to present recommendations for improving the Service. The survey report is to be submitted to Orme Lewis, Assistant Secretary of the Interior, by June 1.

W. Horace Mason has been named vice president; **J. W. Ansley** has been made vice president in charge of production; and **A. P. Acheson** has been elected vice president of sales of Seiberling Rubber Co. of Canada, Ltd., Toronto, Ont. Mr. Mason has been associated with the parent organization, Seiberling Rubber Co., Akron, O., for 26 years; the past two years he spent as secretary-treasurer of the Canadian subsidiary. Mr. Ansley, who has been with the Canadian firm since 1927, rose from various factory supervisory positions to his new post. Mr. Acheson joined the company in 1932 as a salesman and has held a number of sales positions in the firm, including sales manager, prior to his promotion. Mr. Ansley and Mr. Acheson were also named to the board of directors of the Canadian company, which was recently increased from five to seven members to accommodate them. Other directors include: the company's president, Marcus L. Brown, Mr. Mason, and M. C. Deans, all of Canada; and J. P. Seiberling, president, and C. E. Jones, vice president and comptroller, of the parent concern.

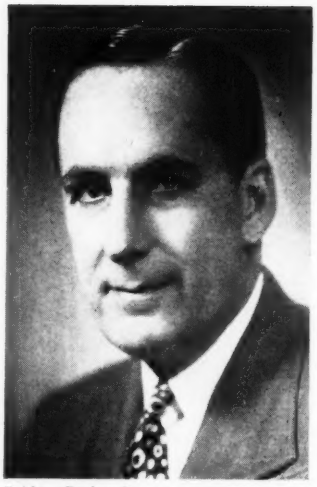
John W. Hagins has been appointed chemical sales representative in New England for the Barrett Division, Allied Chemical & Dye Corp., New York, N. Y. He replaces **J. R. Johnson** in his new post, which includes Maine, New Hampshire, Vermont, Rhode Island, and eastern Massachusetts. Mr. Hagins has been with Barrett since 1952.

John D. Schofield replaces Mr. Hagins as Barrett chemical sales representative in the Minneapolis-St. Paul area, which includes Minnesota, Wisconsin, northwest Illinois, and Iowa. Mr. Schofield was previously with Mathieson Chemical Co.

James W. Dessecker, assistant secretary of Seiberling Rubber Co., Akron, O., and legal counsel for the firm since 1931, recently retired from the company. His duties as legal counsel will be assumed by **Rodney L. Perkins,** an attorney assigned to the secretary's office. Mr. Dessecker joined Seiberling in 1931 as president and treasurer of the company's affiliate, Seiberling Acceptance Corp., and subsequently held the positions of manager of the budget sales department and secretary-treasurer of Seiberling Metal Products Co. until his promotion in 1947 to the secretarial post, from which he has now retired.

Thomas Z. Tatum has been named southeastern representative for Pioneer Latex & Chemical Co., Middlesex, N. J. Mr. Tatum will have his headquarters in Atlanta, Ga., and handle sales of the company's rubber, latex, plastic, and asphalt products.

Albert G. Chenicek has been appointed director of development at Standard Coated Products, Inc., Buchanan, N. Y., with which he has been associated since 1952 when it was a division of Interchemical Corp. Dr. Chenicek joined Interchemical in 1941 after four years with Columbia Chemical Division of Pittsburgh Plate Glass Co. At Interchemical he specialized in synthetic resins for plastics, protective coatings, etc., and was named coordinator of resin research and development before being loaned to Standard.



Fabian Bachrach

William S. Richardson

William S. Richardson has been elected president of The B. F. Goodrich Co., Akron, O., replacing **John L. Collyer** in that post. Mr. Collyer will, however, remain as chairman of the board of directors and chief executive of the company. Mr. Richardson, who had been executive vice president of the firm since 1952, a director, and a member of the executive committee, is also president of B. F. Goodrich Chemical Co. and of Goodrich-Gulf Chemicals, Inc. He joined the parent concern in 1926 and rose through the posts of staff superintendent of the industrial products division (1928), merchandising manager of that division (1931), division general sales manager (1938), and general manager of the industrial and general products sales division (1941). He has been president of Goodrich Chemical since its formation in 1945 and vice president of the parent company since 1951. Mr. Collyer relinquishes the presidency after 15 years of service in that capacity.

Charles H. Kanavel has been named western zone manager for the aeronautical sales department of B. F. Goodrich Co. Tire & Equipment Division, Akron, O. With the company since 1933, Kanavel became Los Angeles district manager in 1946 and will continue in that capacity for both aeronautical and automotive sales in addition to his new assignment. He has held various positions in the firm's production, engineering, and development organizations, having been manager of the industrial tire and track division in Akron before moving to Los Angeles in 1946.

Glenn Crawford, formerly executive vice president and comptroller of the Dunlop Tire & Rubber Corp., Buffalo, N. Y., was promoted to president and treasurer of the corporation recently. Mr. Crawford, a Dunlop employe since 1927, succeeds **David B. Collett,** who served as acting president since last September when **Edward B. Germain,** former president, was granted a leave of absense. Mr. Collett continues as director and vice chairman of the firm; and Mr. Germain continues to serve in an advisory capacity.

William J. Hanlon has been named chief process engineer of the Ashtabula, O., chemical plant of The General Tire & Rubber Co., Akron, O. **William C. Martin** replaces Hanlon as production superintendent of the firm's Mogadore, O., chemical plant. Hanlon joined General in 1952, after having been associated with J. T. Baker Chemical Co. and Mathieson Chemical Corp. Martin has been with General since 1952, having first been employed by J. T. Baker.

Wallace M. Reid has been named technical manager of the latex foam and sporting goods divisions of Dunlop Tire & Rubber Corp., Buffalo, N. Y. A veteran of 28 years' service with Dunlop, Mr. Reid becomes responsible for technical service, development, and quality control of the two product groups. Mr. Reid has worked since 1932 on the production of latex foam and is a member of the RMA committee on this field.

Frederick M. Murdock has been named assistant director of the patent department in the research and engineering division of Monsanto Chemical Co., St. Louis, Mo. He joined Fiberloid Co. in 1932, coming to Monsanto when it acquired Fiberloid. Murdock was a member of Monsanto's plastics division's patent department from 1940-1949 and has been in charge of patent work for the organic chemical division since 1949.

L. E. Judd, public relations director for Goodyear Tire & Rubber Co., Akron, O., was awarded a certificate of outstanding achievement for 1952-53 by the American Public Relations Association. The award, presented at a luncheon on April 6 in New York, N. Y., was won for top performance in publicizing the passenger conveyor-belt idea developed by Goodyear and Stephens-Adamson Mfg. Co.

Joseph F. Weaver has been appointed upper New York and upper Pennsylvania sales representative of the industrial products division of The General Tire & Rubber Co., Akron, O. Mr. Weaver, who has been with General at its Wabash, Ind., plant since 1949, will make his headquarters in Rochester, N. Y.

Donald P. Clarke has been named manager of plastics sales for Canadian Chemical Co., Ltd., and **Hugh Cairns** has joined the company as a plastics sales representative. Both men will be located in the firm's Toronto office.

T. M. Vial has joined the new product development department of American Cyanamid Co., New York, N. Y., after having been technical field representative of Cyanamid's industrial chemicals division for a short time. Dr. Vial was associated with Charles Pfizer Co. before joining Cyanamid.

Dana G. Wager has become comptroller of Dunlop Tire & Rubber Corp., Buffalo, N. Y. Mr. Wager was previously comptroller of Sloane-Blabon Corp. and formerly had been with Tybrand, Ross Bros. & Montgomery. He is a member of the American Institute of Accountants and the New York and New Jersey State Societies of Certified Public Accountants.

The new chemical specialities division of the Pennsylvania Salt Mfg. Co., Philadelphia, Pa., has announced the following appointments: **Paul C. Hurley,** manager of advertising for this division and for the industrial chemicals division and Sharples Chemicals, Inc., is now responsible for sales promotion and market research as well as advertising; **E. S. Garverich,** as technical director in charge of technical service and product development; and **Richard O. White,** formerly superintendent of the company's Montgomery, Ala., plant, as production manager.

Oakite Products, Inc., 19 Rector St., New York 6, N. Y., has announced the assignment of the following new technical service representatives, all of whom recently completed an intensive training course at the company's New York headquarters: **Richard J. Price,** to the Portland, Oreg., area; **Malcolm N. Gray,** Lincoln, Neb.; **John N. Lee,** Miami, Fla.; **Gale R. Miller,** Cincinnati, O.; **Kenneth L. Oliver,** Fort Wayne, Ind.; **Thomas D. Ellsworth,** Grand Rapids, Mich.; **D. O. Mundale,** Asheville, N. C.; **Haskell Wilder,** LaCrosse Wis.; **Lloyd W. Kagley,** Knoxville, Tenn.; **William D. Hudson,** Topeka, Kan.; and **Henry W. Dieter,** Youngstown, O.

Firestone Steel Products Co., Akron, O., has announced the following promotions at its Akron steel products plant: **R. J. Loeven,** superintendent; **J. B. Call,** formerly chief production engineer, production manager; and **D. E. Oldham,** chief production engineer. Mr. Loeven, a member of the Firestone organization since 1940, comes to the plant from the company's Wyandotte, Mich., facility where he was in charge of industrial relations since 1949. Mr. Call joined the firm in 1947; Mr. Oldham has been with the company since 1948.

F. J. Rauscher, district sales manager of the St. Louis sales office of Carbide & Carbon Chemicals Co., New York, N. Y., has been appointed manager of the newly created southwestern sales division of the company. Activities of the new division, which includes the states of Missouri, Arkansas, Louisiana, Texas, Oklahoma, Kansas, Colorado, Wyoming, and Utah, will be directed by Mr. Rauscher from St. Louis, Mo.

Also made public by the firm were the appointments as district sales managers of the following men: **H. L. Harwell,** St. Louis district; **J. W. Ross,** Pittsburgh district; **J. R. Hulten,** Philadelphia district; and **J. F. Luther,** Albany district.

L. N. Larsen, H. Muehlstein & Co., Inc., New York, N. Y., has been reappointed chairman of the traffic committee of the National Association of Waste Material Dealers, Inc. Also reappointed as committee members were **Charles S. Geiger,** of A. Schulman, Inc., and **William Link,** also of Muehlstein.

Joseph J. Wylegala, Emil J. Geering, and **Paul E. Hoch** recently joined the research and development department of Hooker Electrochemical Co., Niagara Falls, N. Y. Both Dr. Wylegala and Dr. Geering have been assigned to the chlorination research group within the department; while Dr. Hoch is to work in the plastics and resins group.

Russel G. Allen, vice president of Godfrey L. Cabot, Inc., chemicals manufacturing firm of Boston, Mass., has been elected executive vice president of that company to succeed Thomas D. Cabot, who was recently elected president. Mr. Allen, a member of the Cabot organization since 1925, is also an officer and director of many of Cabot's subsidiaries.

T. W. Sharp has been named manager of the newly created flexible packaging materials division of Bakelite Co., New York, N. Y. This division will have major responsibility for sales and technical service of all Bakelite polyethylene sold for extrusion of unsupported thin film, and all vinyl cast film and coated paper for flexible packaging applications.

H. J. Hackman, cashier of Dayton Rubber Co., Dayton, O., has been promoted to the position of assistant treasurer of the firm. In charge of all payroll operations and other financial department responsibilities, Mr. Hackman replaces **H. T. Burchard,** who retired recently after 38 years of service. The new assistant treasurer joined Dayton Rubber in 1921.

Francis L. Barga, since 1951 assistant personnel manager for the Muncie, Ind., manufacturing plant of Goodyear Tire & Rubber Co., Akron, O., has been appointed personnel manager of the company's manufacturing plant at Sao Paulo, Brazil. Mr. Barga joined Goodyear in 1945 as manager of the St. Marys, O., plant's labor department.

Thomas A. Printon has been elected board chairman as well as president of Nopco Chemical Co., Harrison, N. J., at a meeting of the company's directors on March 25. With Nopco since 1922, Mr. Printon has been a director since 1936 and president since 1949. As board chairman, he succeeds **Charles P. Gulick,** who was named honorary chairman of the board.

Louis M. Boulware, plant manager of United States Rubber Co.'s Fisk Cord Mills at New Bedford, Mass., has been appointed assistant production manager of the firm's textile division. In his new position he will supervise production at plants in Scottsville, Va., Gastonia, N. C., Hogansville, Ga., Shelbyville, Tenn., and Winnsboro, S. C.

Erhart K. Drechsel has joined the market research department of American Cyanamid Co., New York, N. Y. Mr. Drechsel was formerly with Cyanamid's research division in Stamford, Conn., where his main interests were in the polymer and resin field. Most recently he was responsible for the company's polyester research program.

Schuyler E. Tylee was elected president; **Gerald J. Desmond,** vice president, treasurer, and general manager; and **Arnold Pfister,** secretary and plant manager of Jacques Wolf & Co., Passaic, N. J., following the recent death of Jacques Wolf, founder of the company.

H. E. Humphreys, Jr., president and chairman of the United States Rubber Co., was recently elected president of the Economic Club of New York for a term of one year.

James Crabtree

James Crabtree retired in April from active service with the Bell Telephone Laboratories. Mr. Crabtree was graduated from the University of Manchester and has been engaged in scientific research throughout his professional career. Early fields of endeavor include agriculture and photography. He has made significant contributions to the precision development of sound motion-picture film. For the past 15 years he has been studying the effect of thermal and light activated oxidation as well as other deteriorating factors such as ozone on elastomeric materials. He is the senior author of such papers as "Weathering of Soft Vulcanized Rubber" and "Accelerated Ozone Weathering Test for Rubber." Mr. Crabtree is planning to do consulting work in the field of his recent activities. His home address is Box 342, R. D. 2, Plainfield, N. J.

William W. Scull has been named director of manufacturing services of The B. F. Goodrich Co., Akron, O. Formerly director of purchasing and traffic, Mr. Scull has been associated with the company since 1929, serving in such capacities as chairman of the rubber industry purchasing committee during World War II, manager of the government's synthetic rubber facilities at Port Neches, Tex., and Louisville, Ky., and production manager of all plants operated by Goodrich Chemical Co. In 1947, Scull was named general manager of manufacturing service of the company's Akron plants and was promoted to the position of purchasing and traffic director in 1952. His new position makes him responsible, at the corporate staff level, for most manufacturing functions.

Emil Hladky has been named manager of the new titanium dioxide pigment plant, now under construction near Savannah, Ga., of American Cyanamid Co., New York, N. Y. Hladky joined Southern Mineral Products Corp., Piney River, Va., becoming chief chemical engineer in 1939. This plant was acquired by Cyanamid in 1944, and he was made technical assistant to the plant manager. In 1952, Hladky became manager of Cyanamid's ultramarine blue plant at Newark, N. J. In 1946, Hladky conducted technical investigation work in Germany for the United States Department of Commerce, under loan from Cyanamid. The Hladkys will move to the Savannah area when the new plant nears completion next spring.

F. F. Ogden has been promoted to assistant director of development for the plastics division of Monsanto Chemical Co., Springfield, Mass. In his new position Ogden will remain at his former location in the division's plant at Texas City, Tex. He joined Monsanto in 1935 as a research chemist. Subsequently he was assigned to technical service work in 1937 and became assistant manager of the New York district sales office in 1939. Following three years' service in the Navy, Ogden rejoined Monsanto as sales development and technical service manager for the Merrimac division; transferred to St. Louis in 1950 as a market development specialist for the general development department; and, since 1952, served as sales development manager for Texas City operations.

G. G. Zimmerman has been appointed eastern zone manager of aeronautical sales for the B. F. Goodrich Co. Tire & Equipment Division, Akron, O. Zimmerman will headquarter in Akron and supervise the activities of the Kansas City, Chicago, Milwaukee, Detroit, Dayton, Atlanta, Miami, Washington, and New York districts. With Goodrich since 1924, Zimmerman has served as general traffic manager in Akron; tire salesman in Syracuse; store manager in Akron and Miami; aeronautical division national sales and service representative in Washington; senior salesman in Dayton; and, most recently, manager of the aeronautical division's Dayton district office.

Claude W. Mottinger, purchasing agent for the rubber division of Hewitt-Robins, Inc., has been appointed to the newly created position of director of purchases for the entire company. Mr. Mottinger, a member of the Hewitt-Robins firm since 1951 and previously with The B. F. Goodrich Co., is succeeded as division purchasing agent by **Robert C. Estes,** formerly assistant purchasing agent since 1950. Mr. Mottinger will move his headquarters from Buffalo, N. Y., to the company's executive offices in Stamford, Conn.

Roger C. Bascom was named field sales manager, and **Fred L. McNabb** was made technical service manager of the Hycar and rubber chemicals department of B. F. Goodrich Chemical Co., Cleveland, O. Mr. Bascom, formerly technical service manager, has been with the company for 11 years, before which he was active in the rubber industry for some 15 years. Mr. McNabb started with the parent rubber company in 1935 and joined the subsidiary in 1949 as a staff representative for marketing rubber chemicals.

James E. Cunningham has been appointed to the New York sales staff of Witco Chemical Co., New York, N. Y. Mr. Cunningham joined the company in 1944 as a laboratory technician and rose to the post of manager of the company's Brooklyn stearates plant. He became a member of the technical service staff in 1951.

Lester J. Wolfe has been appointed Chicago district sales manager for Pennsylvania Industrial Chemical Corp., Clairton, Pa. Prior to joining the company as a sales executive last August, Wolfe was assistant sales manager for General Chemical Division, Allied Chemical & Dye Corp. Wolfe has also served as sales director for Man-Gill Chemical Co.

C. E. Webb has been appointed assistant to the president of Sharples Chemicals, Inc., Philadelphia, Pa. A veteran of 13 years of manufacturing experience with the company, his major duties in his new post will be in relation to production.

Perrin G. Smith, who has served in Sharples' research and development departments since 1940, has also been named an assistant to the president. Dr. Smith's duties will consist of staff work in the field of chemical research and development.

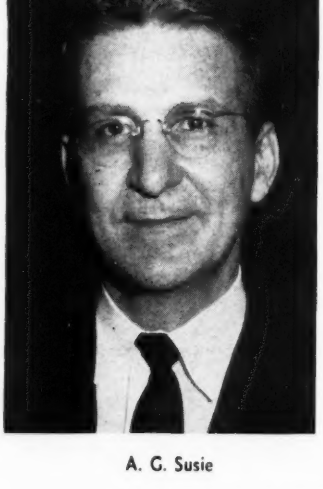
R. W. Sloan has been made manager of market development for Sharples. A member of the development department since 1947, he will now be responsible for the promotion and sale of new products and for market research.

R. E. Workman has been named assistant to the general manager; **C. O. McNeer** has been made general sales manager; and **M. J. Rhoad** has been promoted to assistant to the general sales manager, all newly created posts, of the chemical division of Goodyear Tire & Rubber Co., Akron, O. Mr. Workman will assist in the coordination of the research, development, production, and sales phases of the company's chemical operations. Mr. McNeer, for the past three years in charge of all district sales, will be in charge of all phases of selling chemical materials. Mr. Rhoad, formerly a technical sales representative, will help Mr. McNeer in his assignment.

Thomas F. Callahan, previously with the New York sales office of Witco Chemical Co., 260 Madison Ave., New York 16, N. Y., has been transferred to the Cleveland, O., sales office of the firm.

George Lang has been appointed general superintendent of The Premier Rubber Mfg. Co., Dayton, O. A past chairman of the Southern Ohio Rubber Group, Lang comes to Premier from the Johnson Rubber Co., where he was works manager.

A. G. Susie, formerly associated with the Armour Research Foundation as a senior scientist and as a supervisor in the plastics and rubber section, has joined the technical staff of United Carbon Co., Charleston, W. Va. A holder of several patents and the author of numerous scientific papers, Dr. Susie has been in the field of industrial research since 1939.



A. G. Susie

Frederick W. Gage

Frederick W. Gage has been appointed to the position of technical director of Dayton Chemical Products Laboratories, Inc., West Alexandria, O. Mr. Gage, formerly associated with Columbia Southern Chemical Co. in work involving fine particle rubber pigments, now takes charge of Dayton Chemical's laboratory, technical activities, and sales-service functions relating to research, development, and production of the firm's Thixon bonding agents.

Lawrence N. Holden, Jr., has been appointed New England representative for the plasticizer division of Pittsburgh Coke & Chemical Co., Pittsburgh, Pa. Mr. Holden was previously engaged in a similar capacity in the Detroit-Toledo area.

W. S. Emerson has been named assistant director of the development department of Monsanto Chemical Co.'s research and engineering division. In his new position Dr. Emerson, a member of the Monsanto staff since 1941, will be responsible for liaison with universities and colleges and will be closely associated with the company's fellowship program. He previously held the position of assistant director in charge of organic chemicals and plastics research at the Dayton, O., central research department of the company.

Wilfred Andrew, a veteran of almost 30 years of service with Seiberling Rubber Co., Akron, O., has retired for reasons of health. Mr. Andrew left the position of factory personnel administrator, a post he held since 1946, to take up residence in Arizona as a relief from a respiratory ailment. He rose from foreman through various positions including manager of the labor department and industrial relations manager during his tenure with the company.

Charles R. Witschonke was named manager of the newly formed physical-analytical section of the Bound Brook, N. J., research laboratories of American Cyanamid Co., 30 Rockefeller Plaza, New York 20, N. Y. Dr. Witschonke joined Cyanamid in 1945 as a research chemist and most recently was head of the physical-chemical measurements laboratory at Bound Brook. He had previously been associated with Brown University and with the Naval Research Laboratory.

Six new appointments in the international division of United States Rubber Co., New York, N. Y., all to be headquartered at the company's home office, have been announced. These are: **Albert E. Denari,** formerly assistant regional director of Buenos Aires, now director of South American operations; **Eugene J. Dailey,** who was regional director in Central America, now director of European operations; **Gustav J. Russ,** formerly general sales manager of the division, now manager of export sales; **Edward J. Higgins,** formerly general production and development manager, now director of head office operations; **Hani J. Korkegi,** previously regional director of Far Eastern territory, now regional manager of the Pacific area with special assignments; and **Harry Wintsch,** who was plant manager of the company's synthetic rubber plant in Naugatuck, Conn., now manager of the Naugatuck Chemical department of the division.

The recently formed chlorinated products division of Diamond Alkali Co., Cleveland, O., has named **D. J. Porter,** assistant to the director of research, to the post of assistant general manager and division research director; **J. J. Lukes,** development section manager, to research manager; **W. B. Beeson, Jr.,** sales manager since last year of Belle Alkali Co., to product sales manager for chlorinated solvents and chemicals manufactured by Belle; **W. J. Esselstyn,** technical service representative, to solvent sales manager; **M. T. Walsh,** sales promotion representative, to sales manager in charge of Chlorowax and related products; and **D. C. Nevling,** plant auditor at the company's Houston works, to divisional administrative assistant.

The associated tires and accessories division of The B. F. Goodrich Co., Akron, O., announced that **M. F. Duffy,** previously northeastern zone manager for the division, has been made eastern zone manager, and that **W. A. Hartquist,** formerly budget and general store supervisor of Brown Auto stores, has been named field merchandiser in the north central zone. Mr. Duffy, a member of the Goodrich organization since 1935, is now responsible for the area east of Akron and south to South Carolina. Mr. Harquist joined the rubber company in 1935, becoming associated with Brown Auto in 1948.

The appointment of four men to positions of assistant sales managers of various chemicals has been announced by the Barrett Division of Allied Chemical & Dye Corp., New York, N. Y. They are: **Cass Cislo,** for phthalic anhydride, maleic anhydride, and fumaric acid; **R. S. Hunicke,** for aromatic solvents, acetone, glycols, and crude distillates; **A. G. DeMeurisse,** for phenols and other tar acids, tar bases, and niacin; and **J. E. Shand,** for plasticizers, "Cumar" resin, naphthalene, and rubber compounding materials.

Sales changes at Anaconda Wire & Cable Co. include the promotion of **Jack Saunders** to manager of the newly created sales district covering the State of Florida, with headquarters in Tampa; **Robert W. Carmichael,** to assist Mr. Saunders; **Frank D. Dickey,** as manager of the San Francisco district to replace **Lee Hayward; Dick Riley** to assist Mr. Dickey; **Howard Davies,** as salesman for the Pittsburgh district; and **Thomas F. Jackson,** as salesman in the Chicago district office.

J. Le Bras has been honored in France by nomination in the Legion of Honor in recognition of his services to the rubber industry. Dr. Le Bras, who joined the Institut Français de Caoutchouc at its inception in 1936 as chemist, has directed the Institut's research center since 1940. In 1949 the Institut and the Indo-China Rubber Research Institute appointed him scientific inspector-general charged with co-ordinating the work of both organizations and with maintaining liaison with international scientific and technical centers. Dr. Le Bras has visited the United States on several occasions, the latest in the current year when, at a meeting of the Washington Rubber Group on March 1, he spoke on the natural rubber situation in Indo-China.

Dan Schoenholz has been promoted to director of the product development department of Foster D. Snell, Inc., New York, N. Y. Assistant director of the department will be **Bernard Berkeley.** Schoenholz joined Snell in 1944 and has been a research group director in charge of wax, paint, and varnish work. In his new position he will be in charge of product development, applied research, and testing of paints, waxes, varnishes, polishes, inks, adhesives, and chemical specialties. With Snell since 1944, Berkeley has been a group leader in the field of chemical specialties.

Norman P. Bekkedahl, of the National Bureau of Standards, Washington, D. C., has received the U. S. Department of Commerce Silver Medal for Meritorious Service for "outstanding service nationally and internationally, and for valuable contributions to science and technology in the field of rubber chemistry, including meritorious authorship." Dr. Bekkedahl joined NBS in 1931 and has, during his tenure at the Bureau, made many pioneer advances in rubber science, including the application of thermodynamics to the chemistry of rubber and the application of dilatometry to the study of transitions in rubber. His services as delegate to international congresses, to the Brazilian Government, and on the ASTM Committee on Crude Natural Rubber have been outstanding. He is very active in various scientific associations, having held the presidency of the Chemical Society of Washington and of Alpha Chi Sigma (professional chemical fraternity).

Norman P. Bekkedahl

OBITUARY

Pierre S. du Pont

DEATH came suddenly, on April 5, in Wilmington, Del., to Pierre Samuel du Pont, industrialist, philanthropist, and head of the du Pont family.

He was born January 15, 1870, near the site of the first du Pont powder mills, built in 1802 on the Brandywine Creek, near Wilmington, by his great grandfather. Pierre du Pont was educated at The William Penn Charter School in Philadelphia and at Massachusetts Institute of Technology, from which he was graduated in 1890.

He immediately went to work in the family powder mills as a chemist and from 1892 to 1899 was assistant superintendent of the Carney's Point, N. J., plant. Then he left the family business to undertake the management of various properties in Lorain, O., and became president of Johnson Co., former owner of Lorain Steel Co., now part of the United States Steel Corp.

Then in 1902, Pierre du Pont joined his cousins, T. Coleman du Pont and Alfred I. du Pont, in purchasing the family powder business, which was in danger of passing into other hands. The cousins formed a new corporation, E. I. du Pont de Nemours Co., of Delaware, forerunner of the present company. Pierre du Pont served as treasurer, then as vice president, and then as acting president.

In 1915, when Coleman du Pont offered to sell his du Pont stock, a group led by the deceased purchased the shares, forming Christiana Securities Co. Pierre du Pont was elected its president and did not relinquish that position until May, 1950.

Coleman du Pont resigned the presidency of the du Pont company in 1915 and Pierre succeeded him and also became chairman of the finance committee. It was during his tenure of office, during World War I, that the company branched from a manufacturer of explosives to one making dyes, paints, coated fabrics, plastics, and numerous related chemical products.

Pierre du Pont resigned as president of the company on May 1, 1919, to become chairman of the board of directors. He continued also until 1926 as chairman of the finance committee. Then in May, 1940, he resigned as board chairman, but remained as a director and a member of the finance committee. He was honorary chairman of the board when he died.

Early in the century General Motors Corp. was organized by Mr. du Pont and his associates. He was elected its president in 1920; he resigned in 1923, but continued as chairman of the board. That post he resigned in 1929, but he remained a director until 1944.

Mr. du Pont served 12 years (1925-37) as State Tax Commissioner for Delaware. With the repeal of the Eighteenth Amendment he was also appointed a one-man liquor control commission for Delaware. He was a member of President Hoover's National Committee on Unemployment in 1931 and in 1933 became a member of the NRA Industrial Advisory Board and of the National Labor Board. He also donated millions of dollars for the improvement of schools in Delaware and Pennsylvania and built a large modern hospital in West Chester, Pa.

The deceased belonged to only a few clubs and was a director of Wilmington Trust Co. and Pennsylvania Railroad Co. He was a member of Franklin Institute, American Academy of Political Science, American Philosophical Society, American Chemical Society, American Association for the Advancement of Science, and the Society of Automotive Engineers. He was a life member of the Massachusetts Institute of Technology Corp. and the recipient of honorary degrees from Lafayette College and the University of Delaware.

On April 2, 1954, Pierre du Pont was made a commander of the Legion of Honor in France. He had been a chevalier since soon after World War I and later was honored with the rank of officer.

A childless widower, he is survived by a brother and a sister, besides several nephews and nieces.

Private funeral services were held on April 8.

Arthur B. Newhall

AFTER a long illness Arthur Brock Newhall, a Rubber Coordinator during World War II, died in Framingham Union Hospital, Framingham, Mass., on March 12. Funeral services were conducted in Storey Chapel on March 16, followed by interment in Mt. Auburn Cemetery, Cambridge, Mass.

Mr. Newhall was born in Lynn, Mass., on August 17, 1884.

After graduation from Tufts College, with an M.E. degree, in 1908, he was an instructor in mechanic arts in Lynn English High School and then at Salem (Mass.) Technical High School. In June, 1912, he entered the mechanical engineering department of Wentworth Institute, Boston, where he remained until August, 1917, when he began his successful career in the rubber industry, with Hood Rubber Co., Watertown, Mass.

The deceased acted as purchasing agent, office manager, merchandise manager, branch auditor, manager of the tire department, general manager, executive vice president (1929), and president and a director of Hood (1938). In 1937 he had been elected a director and a member of the executive committee of The B. F. Goodrich Co., Akron, O., parent company of the Hood concern.

In 1939, however, Mr. Newhall left the rubber industry to become executive vice president of Talon, Inc., Meadville, Mass., where he remained until August, 1941, when he served as a dollar-a-year man in Washington, D. C. It was during this period that he was United States Rubber Coordinator and executive director of the Combined Production & Resources Board.

In October, 1943, he became treasurer and a director of Dennison Mfg. Co., Framingham, positions he held until his death. He was also a director and chairman of the board of Cambridge Rubber Co. and General Latex & Chemical Co., both of Cambridge, Mass.; a director of The Rubber Manufacturers Association, Inc., Arrow Mutual Liability Insurance Co., Second National Bank, Boston, Framingham National Bank, and Associated Industries of Massachusetts; and a past president of Framingham Union Hospital.

In 1953, Mr. Newhall was elected a life trustee of Tufts College, after having served several five-year terms as alumni trustee to the college. He was also an honorary member of Wentworth Institute and of the National Office Management Association and a member of Newcomen Society in North America, National Panel of Arbitrators, Zeta Psi, Tau Beta Pi, University Club of Boston, and National Planning Association, Committee of New England.

Survivors include two daughters and two sisters.

Dan M. Rugg

THE unexpected death of Dan M. Rugg, 64, vice president of Koppers Co., Inc., occurred in Pittsburgh, Pa., on March 28 due to the development of complications following an operation on March 23.

Senior vice president of Koppers in point of service, the deceased was widely known throughout the country for his work in the company's chemical division and for his service to the government in the synthetic rubber field during World War II. He began his career with the Illinois Steel Co. following graduation from the University of Illinois in 1910 as a mechanical engineer. He was subsequently associated with various coke and steel producers until 1926, when he joined Koppers as a sales engineer. His promotions to vice president of the Brooklyn division (1928), vice president of the butadiene division (1942), and vice president and general manager of the chemicals division (1946) testifies to his service to the company. Under his leadership, the chemical division has expanded a great deal, today encompassing six producing units scattered over the country.

Mr. Rugg was also active in industrial organizations, including the Manufacturing Chemists Association, where he served as a member of the board of directors and as a member of the public relations committee.

He is survived by his wife, a son, and a daughter.

Burial took place in Champaign, Ill., Mr. Rugg's birthplace.

Charles W. Staacke

A HEART attack caused the sudden death, in Detroit, Mich., on April 9, of Charles W. Staacke, 56, technical adviser on conveyor and belting sales for Hewitt-Robins, Inc., Buffalo, N. Y. Funeral services were held at his home in Williamsville, N. Y.

A graduate of Ohio State University, he had worked for many years (1925-34 and 1936-48) with The B. F. Goodrich Co. before joining Hewitt in 1948.

An outstanding conveyor belt expert in the United States, Mr. Staacke pioneered many important advances in belting construction and wrote technical articles not only on belt design and construction, but on the overall problems of engineering long lines conveyor equipment. He also edited the belting sections of a number of engineering handbooks in the conveyor field.

He leaves his wife.

FINANCIAL

Pittsburgh Coke & Chemical Co., Pittsburgh, Pa., and subsidiaries. Year ended December 31, 1953: net earnings, $2,855,000, equal to $2.63 each on 916,907 common shares, compared with $2,163,000, or $2.12 each on 815,097 shares, in the preceding year; net sales, $52,212,000, against $38,700,000.

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S. S. White Dental Mfg. Co., Philadelphia, Pa. For 1953: net profit, $906,262, equal to $2.46 a common share, against $833,205, or $2.31 a share, in 1952.

Westinghouse Air Brake Co., Wilmerding, Pa., and subsidiaries. Year ended December 31, 1953: net profit, $10,009,199, equal to $2.43 each on 4,124,366 capital shares, against $10,515,186, or $2.55 each on 4,123,622 shares, the year before: net sales, $145,088,997, against $93,619,110; income and excess profits taxes, $9,390,000, against $10,475,000; current assets, $98,209,570, current liabilities, $26,355,204, against $84,379,530 and $24,941,147, respectively, on December 31, 1952.

Western Electric Co., Inc., New York, N. Y. For 1953: net earnings, $52,604,613, equal to $4.55 a common share, against $47,081,705, or $4.48 a share, in 1952.

United States Rubber Co., New York, N. Y., and subsidiaries. Year ended December 31, 1953: net income, $32,732,300 (a record), equal to $5.19 each on 27,523,572 common shares, contrasted with $28,169,955, or $4.33 each on 22,961,227 shares, in the preceding year; net sales, $838,451,008, against $850,151,566; income and excess profits taxes, $39,883,436, against $60,384,335; current assets, $359,597,174, current liabilities, $128,340,940, against $361,757,637 and $155,521,338, respectively, on December 31, 1952.

United Engineering & Foundry Co., Pittsburgh, Pa. For 1953: net profit, $3,806,031, equal to $1.52 a common share, against $3,772,906, or $1.51 a share, in 1952.

United Elastic Corp., Easthampton, Mass. For 1953: net earnings, $1,471,141, equal to $5.44 a share, compared with $1,902,088, or $7.03 a share, the year before.

United Carbon Co., Charleston, W. Va., and subsidiaries. For 1953: net income, $3,886,558, equal to $4.88 each on 795,770 capital shares, compared with $3,597,739, or $4.52 a share, in 1952: net sales, $34,369,254, against $30,624,244; income taxes, $2,120,000, against $2,333,000.

Union Carbide & Carbon Corp., New York, N. Y., and subsidiaries. For 1953: net earnings, $102,783,442, equal to $3.55 each on 28,952,794 capital shares, compared with $98,320,699, or $3.41 each on 28,806,344 shares, in 1952: net sales, $1,025,833,041, against $956,931,021.

Union Asbestos & Rubber Co., Chicago, Ill. For 1953: net income, $164,736, equal to 35¢ each on 475,176 capital shares, contrasted with $617,236, or $1.30 a share, in 1952; net sales, $11,401,193, against $12,913,116; federal income taxes, $180,000, against $570,000.

Struthers Wells Corp., Titusville, Pa. Quarter ended February 28, 1954: net profit, $430,860, against $365,178 in the 1953 period.

St. Joseph Lead Co., New York, N. Y. For 1953: net profit, $6,300,342, equal to $2.32 a share, contrasted with $9,638,455, or $3.55 a share, in 1952.

The Timken Roller Bearing Co., Canton, O., and subsidiaries. For 1953: net earnings, $10,856,402, equal to $4.48 a share, compared with $10,596,534, or $4.38 a share, the year before; net sales, $178,164,701, against $169,632,883; income taxes, $20,603,500, against $20,035,000; excess profits taxes, 6,645,000, against $6,175,000.

The Thermoid Co., Trenton, N. J. For 1953: net income, $1,240,714, equal to $1.40 a share, against $1,084,832, or $1.20 a share, in 1952; sales, $36,747,012, against $36,450,756.

Taylor Instrument Cos., Rochester, N. Y. Six months to January 31, 1953: net profit, $547,553, equal to $3.03 a common share, contrasted with $251,584, or $1.39 a share, in the like period last year.

Seiberling Rubber Co., Akron, O. Year ended December 31, 1953: net earnings, $1,035,740, equal to $2.10 each on 391,430 common shares, compared with $948,915, or $1.94 each on 376,010 shares, the year before: net sales $40,351,305, against $41,646,702; income and excess profits taxes, $1,003,131, against $1,325,000; current assets, $15,946,988, current liabilities, $4,867,573, against $14,945,441 and $4,902,482, respectively, at the end of 1952.

Pittsburgh Plate Glass Co., Pittsburgh, Pa., and subsidiaries. For 1953: net earnings, $36,864,785, equal to $4.07 a share, against $36,771,925, or $4.07 a share, in 1952: net sales, $451,964,697, against $402,055,085; income and excess profits taxes, $39,300,000, against $40,100,000; current assets, $211,517,925, current liabilities, $98,530,480, against $205,000,575 and $87,586,228, respectively, on December 31, 1952.

Stauffer Chemical Co., New York, N. Y. For 1953: net income, $5,464,000, equal to $2.55 a common share, against $4,520,000, or $2.20 a share, in 1952: sales, $76,638,000, against $70,184,000.

Raybestos-Manhattan, Inc., Passaic, N. J., and domestic subsidiaries. Year ended December 31, 1953: net earnings, $3,361,506, equal to $5.35 each on 628,100 capital shares, compared with $3,175,611, or $5.05 a share, a year earlier; federal income taxes, $4,425,000, against $5,180,000; net sales, $74,277,791, against $73,230,550; current assets, $27,976,092, current liabilities, $7,411,612, against $27,789,141 and $6,911,543, respectively, on December 31, 1952.

Phillips Petroleum Co., Bartlesville, Okla. For 1953: net income, $76,760,231, equal to $5.25 a share, against $75,284,261, or $5.17 a share, in 1952.

O'Sullivan Rubber Corp., Winchester, Va. For 1953: net earnings, $131,614, equal to 26¢ a share, compared with $157,671, or 32¢ a share, in 1952.

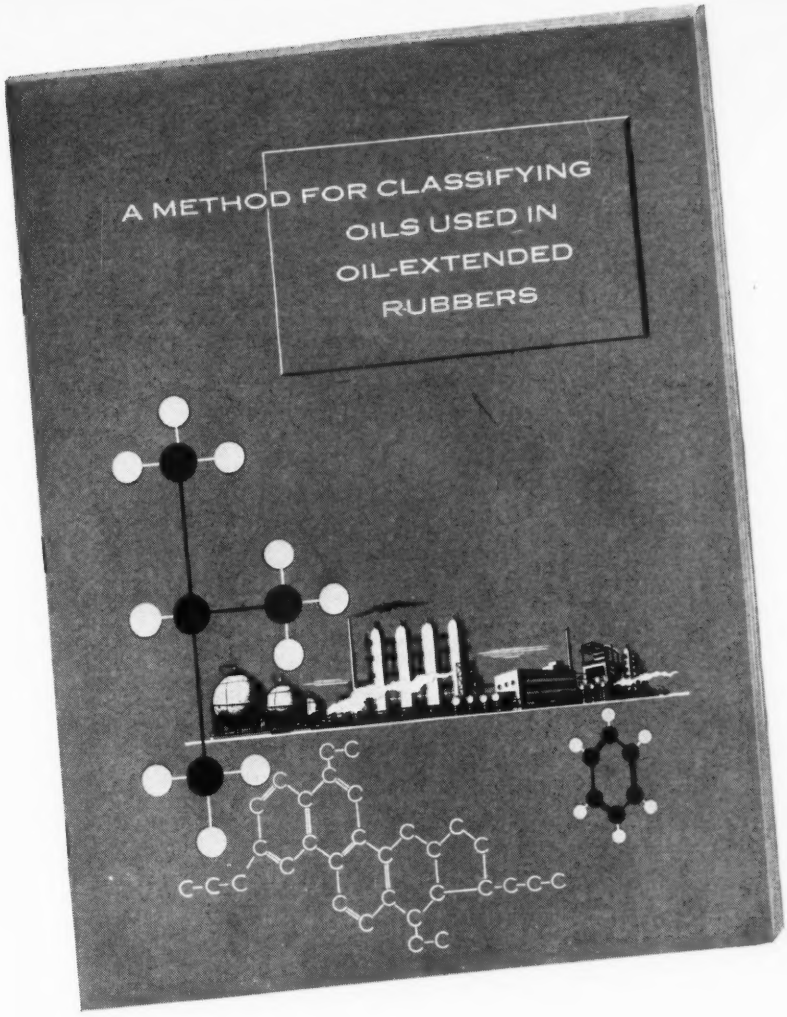
New Jersey Zinc Co., New York, N. Y., and subsidiaries. For 1953: net income, $2,713,887, equal to $1.38 each on 1,960,000 capital shares, contrasted with $12,060,192, or $6.15 a share, the year before; sales, $12,085,803, against $22,651,395; income taxes, $975,000, against $4,500,000.

National Lead Co., New York, N. Y. For 1953: net earnings, $30,848,928, equal to $2.58 a share, against $23,060,054, or $2.06 a share, in 1952.

(Continued on page 284)

Dividends Declared

Company	Stock	Rate	Payable	Stock of Record
Acushnet Process Co.	Com.	$0.25 q.	Mar. 12	Mar. 1
American Hard Rubber Co.	$3.50 Pfd.	0.87½ q.	Mar. 31	Apr. 22
Baldwin Rubber Co.	Com.	0.15 q.	Apr. 27	Apr. 15
		0.10 extra	Apr. 27	Apr. 15
Borg-Warner Corp.	Pfd.	0.87½ q.	Apr. 1	Mar. 17
Canada Wire & Cable Co., Ltd.	Cl. A	1.00 q.	Mar. 15	Mar. 1
	Cl. B	0.75 q.	Mar. 15	Mar. 1
Canadian General Electric Co., Ltd.	Com.	2.00 q.	Apr. 1	Mar. 15
Circle Wire & Cable Corp.	Com.	0.40 q.	Mar. 25	Mar. 11
Crown Cork & Seal Co., Inc.	Com.	0.15 q.	Apr. 21	Apr. 6
Dayton Rubber Co.	Com.	0.25 q.	Apr. 26	Apr. 9
	Cl. A	0.50 q.	Apr. 26	Apr. 9
Detroit Gasket & Mfg. Co.	Com.	0.25 q.	Apr. 26	Apr. 12
DeVilbiss Co.	Com.	0.30 q.	Apr. 22	Apr. 12
E. I. du Pont de Nemours, Inc.	Com.	1.00 q.	Mar. 13	Feb. 23
	$4.50 Pfd.	1.12½ q.	Apr. 24	Apr. 9
	$3.50 Pfd.	0.87½ q.	Apr. 24	Apr. 9
Garlock Packing Co.	Com.	0.25 q.	Mar. 31	Mar. 19
General Cable Corp.	Com.	0.15 q.	Apr. 1	Mar. 5
	1st Pfd.	1.00 q.	Apr. 1	Mar. 5
	2nd Pfd.	0.50 q.	Apr. 1	Mar. 5
General Electric Co.	Com.	1.00 q.	Apr. 26	Mar. 19
General Motors Corp.	$5.00 Pfd.	1.25 q.	May 1	Apr. 5
	$3.75 Pfd.	0.93¾ q.	May 1	Apr. 5
General Tire & Rubber Co.	4¼% Pfd.	1.06¼ q.	Mar. 31	Mar. 19
	3¾% Pfd.	0.93¾ q.	Mar. 31	Mar. 19
	3¼% Pfd.	0.81¼ q.	Mar. 31	Mar. 19
Goodall Rubber Co.	Com.	0.15 q.	May 15	May 1
	5% Pfd.	2.50 semi-a.	May 15	May 1
B. F. Goodrich Co.	Com.	0.80 q.	Mar. 31	Mar. 12
Goodyear Tire & Rubber Co.	Com.	0.75 q.	June 15	May 17
	Pfd.	1.25 q.	June 15	May 17
Goodyear Tire & Rubber Co., of Canada, Ltd.	Com.	1.00 q.	Mar. 31	Mar. 10
		2.00 extra	Mar. 31	Mar. 10
Byron Jackson Co.	Com.	0.37½ q.	May 15	Apr. 30
Johns-Manville Corp.	Com.	0.75 q.	Mar. 11	Mar. 1
Johnson & Johnson	4% Pfd. C	1.00 q.	May 1	May 1
I. B. Kleinert Rubber Co.	Com.	0.25 q.	Mar. 12	Feb. 26
Lee Rubber & Tire Corp.	Com.	0.75 q.	May 1	Apr. 15
		0.50 extra	May 1	Apr. 15
Midwest Rubber Reclaiming Co.	Com.	0.25 q.	Apr. 1	Mar. 8
	Pfd.	0.56¼ q.	Apr. 1	Mar. 8
Parke, Davis & Co.	Com.	0.35 q.	Apr. 30	Apr. 12
Raybestos-Manhattan, Inc.	Com.	0.50 q.	Mar. 12	Feb. 26
Rome Cable Corp.	Com.	0.35 q.	Mar. 30	Mar. 10
A. G. Spalding & Bros.	Com.	0.25 q.	Mar. 15	Mar. 8
Thermoid Co.	Com.	0.10 q.	Mar. 31	Mar. 10
	$2.50 Pfd.	0.62½ q.	May 1	Apr. 12
United Elastic Corp.	Com.	0.60 q.	Mar. 10	Feb. 26
Viceroy Mfg. Co., Ltd.	Cl. A	0.12½ q.	June 15	June 1



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MALAYA

Investigations on *Hevea* Latex

Investigations on *Hevea* latex form the subject of Communications No. 284, Vol. 14, and No. 287, Vol. 14, issued by the Rubber Research Institute of Malaya. In the former M. W. Philpott and D. R. Westgarth discuss, "Stability and Mineral Composition of *Hevea* Latex." Investigations on mature seedling trees at the experiment station of the Institute have indicated that latex stability is affected by fertilizer treatment and is also associated with the amount of mineral constituents in the latex—low potassium and phosphorous and high magnesia tending to be found in conjunction with low stability. Manuring with phosphate and potash fertilizers appeared to reduce the magnesium content and raise the phosphorous and probably the potassium content of the latex and at the same time to increase mechanical stability.

Clonal latices from different estates were also examined, and some inconsistencies were revealed, but it is suggested that local conditions are probably responsible here. However some clones, particularly Glenshiel 1, yielded latex of abnormal stability wherever planted.

The investigations support the belief that the relation between the phosphate and magnesium constituents is important in determining the natural stability of latex that has been ammonia preserved.

In Communication No. 287, R. H. Smith reports on the composition and variations in composition of the phosphatides in *Hevea* latex. The phosphatides and other lipin substances were extracted from fresh latex in the form in which they are believed to occur naturally. Analyses indicated the composition of total lipin—after removal of water-soluble impurities—as follows: approximately 51% lecithin, 10.5% inositol phosphatide, 3% phosphatidyl ethanolamine, 20% trigylcerides, and 15.5% unsaponifiables. An enzyme capable of liberating choline from the lecithin compound was found in fresh latex when coagulated with formic acid, in alcohol below 40° C., or by freezing. This enzyme was inactive in untreated fresh latex, and it was destroyed by the ammonia or formaldehyde present in preserved latex. Destruction was rapid with 0.7% ammonia and 0.6% formaldehyde, slower when the concentration was 0.2%, as used for temporary preservation. Hence rubber prepared from temporarily preserved latex is likely to contain the phosphatide more or less undegraded by the enzyme and consequently probably contains choline in combined form. In latex ammoniated to 0.7% and stored for a prolonged period the phosphatide is slowly destroyed until little or none of it remains.

So far it has been impossible to say whether variations in the amount of phosphatides in rubber prepared under different conditions, affect the properties of rubber. Choline chloride has a marked activating influence on rate of cure, but it is not known whether choline combined in the phosphatide would have a similar effect.

Studies of phosphatide changes on storing fresh latex led to the conclusion that it was unlikely that phosphatide breakdown is a factor in spontaneous coagulation, though it may contribute toward this in special cases.

New Emphasis on Research

Relatively little comment has appeared so far on the news that three large concerns intend to start manufacturing synthetic rubbers in Britain. The problem of meeting competition from synthetic rubber in general has lately been prominent in local discussion, however, and it is to be noted that intensive research to improve the quality of natural rubber and reducing costs of production are being recommended, instead of buffer stocks and appeals to America. Recent advances in natural rubber research and the increased use of natural rubber in the United States under the stimulus of low prices have apparently pointed out the way toward "living with synthetic rubber." A new spirit of determination to make necessary sacrifices to attain the desired goal and a quiet optimism that this can be achieved seem to be much in evidence from certain leaders in rubber circles.

The ways in which research could aid rubber to compete with its synthetic rival have been discussed in the *Planters' Bulletin* of March, 1954, in a rather lengthy editorial, "Can

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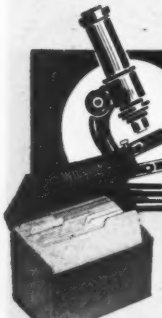

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Research Save Natural Rubber?" People in Malaya, it warns, secure in the fact that most rubber goes into tires and that here synthetic rubber has so far shown no real superiority over natural, are not taking the situation of natural *versus* synthetic rubber seriously enough. Natural rubber's edge over synthetic for use in tires is liable to be forfeited to new developments of exceptional copolymers like those using isocyanates or epoxy compounds. Unremitting research on synthetics has brought about this state of affairs. But what research can do for synthetic, it can do for natural rubber.

The editorial suggests the possibility of producing from natural rubber a copolymer with other suitable monomers, that has the outstanding properties needed today; in this, sulfur vulcanization would be replaced by cross-linking by the additional monomer. Possibilities in this direction are already being investigated in research institutes in England as well as in Malaya.

The editorial next goes on to discuss the role of research in reducing production costs. The factors for consideration here are: labor involved in the mechanics of tapping and collecting; yields; and preparation. No advances are expected in regard to the first item; further progress in increasing yields can be achieved, but would be slow; mechanization of preparation (which would yield a cheaper and more uniform rubber) seems to offer prospects, although so far efforts in this direction undertaken in several countries have not yielded a wholly satisfactory process. At present the Rubber Research Institute in Malaya is studying the mechanisms of latex coagulation and of drying coagulum to obtain basic data for the design of an efficient machine for converting latex into dry rubber.

Finally, Malayan producers are urged to make an all-out effort to promote the use of natural rubber latex. New methods of preserving and treating natural latex must be developed, but it is warned that, when a new type of latex is thus produced, the manufacturers should at the same time be presented with new or technological processes to go with it.

It was also brought out what a small amount of money is expended by natural rubber interests on natural rubber research, as compared with that made available by the United States for synthetic rubber research, and the implication is that the expenditures on the former should be brought nearer the level of the latter if corresponding results are to be expected.

Here we may point out that new budgets for research programs in England and Malaya are being studied in London by Sir Eric Miller at the request of the Rubber Growers' Association. The cess of half cent (Straits) a pound on rubber exported from Malaya is insufficient to meet expenses of programs due to the decrease in rubber purchases abroad. Not long ago the Rubber Producers' Council had agreed by a majority to increase the cess so that research could continue on the same level as in the past five years. However, no actual steps in this direction will be taken until Sir Eric's report, which is expected by the end of May, has been examined by interested parties.

Synthetics Promote Use of Linatex

In the course of the editorial cited above, it was remarked that the synthetic industry had come into being largely by "stepping on the shoulders of the industry built up by the natural rubber producers over half a century," and it was added that perhaps in return, natural rubber could utilize the techniques of synthetic rubber production to insure its place in the forefront.

An item in a recent issue of *Malay Mail* on the growing demand for Linatex (the rubber engineering product made by Wilkinson Process Co., Ltd.) shows another way in which natural and synthetic rubber can reciprocally benefit and stimulate each other.

Bernard Wilkinson, managing director of the international chain of companies selling Linatex products, recently visited Malaya to direct the expansion and modernization of the company's factory at Batu Caves, and in an interview stated that for the engineering uses of rubber, synthetic rubber has been an education for prospective customers. They choose synthetics of a certain quality which may not fully meet their needs, he said, and are then partially converted to a natural rubber material and try Linatex. The development of synthetic rubber-like materials, he added, has broadened the scope of application for oil and heat resistance, and so on, and has thus educated the customer in their use.

Linatex, which is made from latex by a special process invented by Mr. Wilkinson in 1923, has been produced since 1926. At present the Batu Caves factory uses 100,000 pounds of natural rubber a month and, though working three shifts, is unable to keep up with orders, it was revealed.

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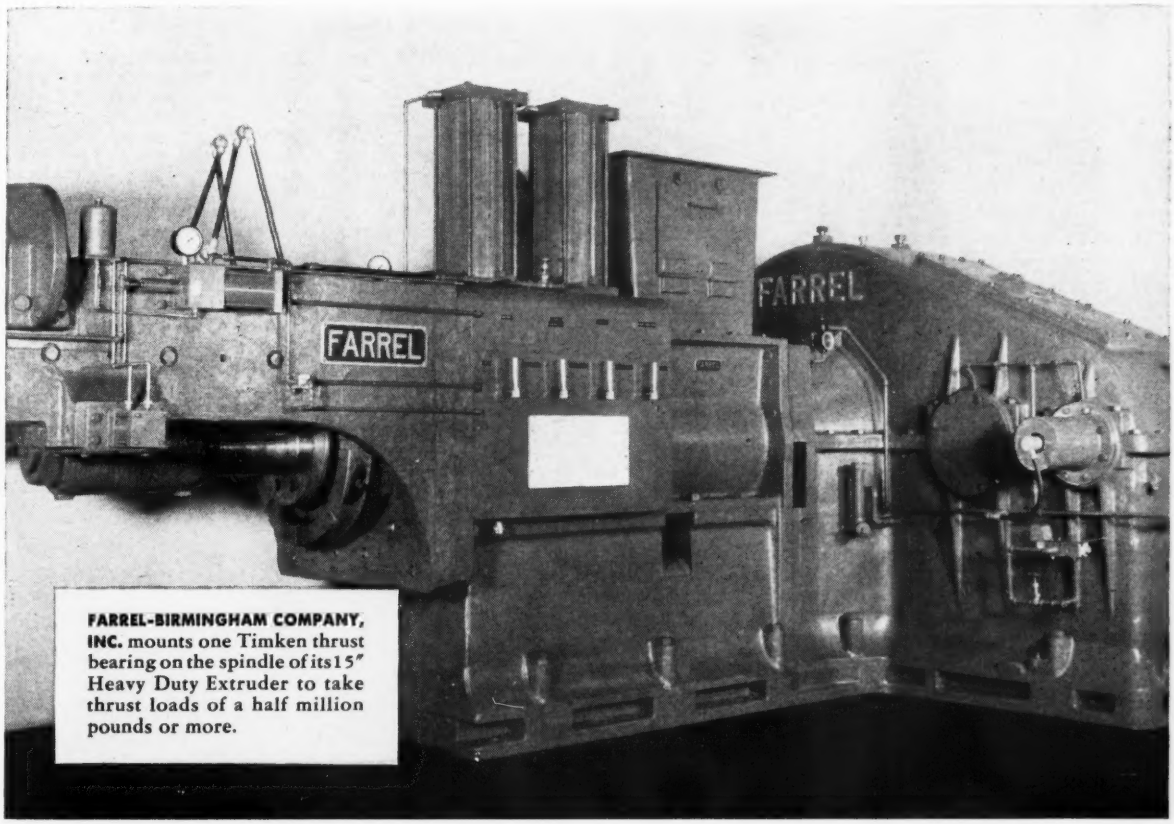

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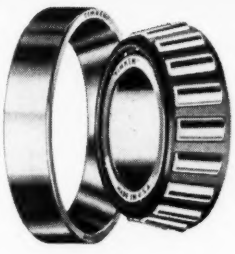

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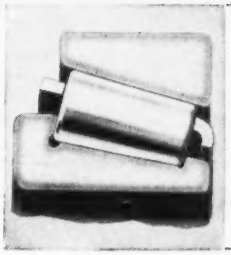

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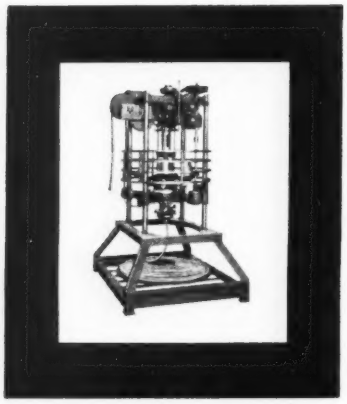

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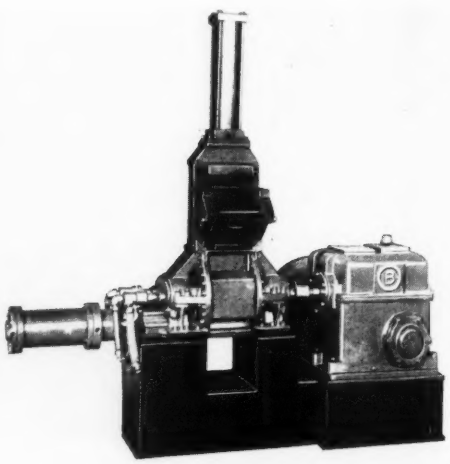
Hook-on Volt-Ammeter—AK-5

AN AUTOMATIC scale changing volt-ammeter of the hook-on type has been developed by General Electric Co., Schenectady, N. Y., for use in measuring current and voltage quickly and accurately. Designated AK-5, the pocket-size instrument has a current range of 5/20/80/350 amperes and an a.c. voltage range of 150/300/750. As a voltmeter, the unit is said to be accurate up to 3% of full scale and to be capable of withstanding a voltage breakdown test of 4,000 volts.

The AK-5 will clamp around any conductor up to two inches in diameter. Its contoured trigger closes and opens the hook-on assembly, which is covered with insulation. The desired scale and range are obtained by turning a switch knob. Weight of the instrument is 1¼ pounds; dimensions are 9⅛ by 3 5/16 by 1 9/16 inches.



Laboratory-Size Intensive Mixer by Bolling

Bolling Intensive Mixer

A NEW laboratory-size unit has been added to the line of intensive mixers made by Stewart Bolling & Co., Inc., 3192 E. 65th St., Cleveland 27, O. The new mixer has a capacity of six pounds of 1.5 gravity stock in rubber or plastics; whereas the production units range in chamber capacities from 100-475 pounds.

The laboratory machine has the same construction features as the larger mixers, including Spiral-Flow sides for circulating cooling water or heating steam; split-end frames for strength and accessibility to rotors, bearings, shroud plates, and dust

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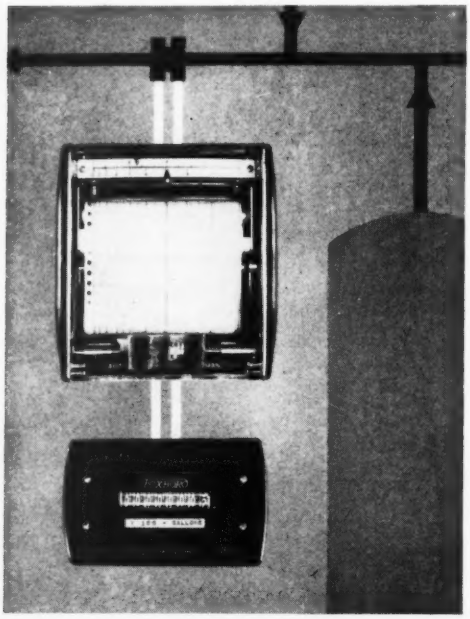

Foxboro Type 224 Receiver-Integrator Panel Mounted below a Recorder

Receiver-Integrator for Graphic Panels

THE Type 224 receiver-integrator for graphic panels, a pneumatic-electric instrument that computes an accurate, continuous total of any process flow and operates a small counter on the panel, has been developed by The Foxboro Co., 624 Neponset Ave., Foxboro, Mass. The integrator consists of two small self-contained units: a remote counter and a flow receiver. The counter can be mounted on the panel and totalizes to eight digits (or to six digits with zero reset wheel). The flow receiver unit, consisting of a receiver bellows and a cam switch assembly, is housed in a small metal box behind the panel and connected to the counter by two wires.

In operation, pneumatic measurement signals in the range of 3-15 psi. from a flow transmitter at the process are received by the bellows, which then positions the cam switch mechanism. The cam switch, in turn, sends an electric impulse to the counter in precise relation to the flow measurement. Integrators are available for uniform or square root scales to totalize minute, hourly, or daily rates. Service calibration checks can be made during actual operation without the need of extra equipment.

Cord Twister-Winder Machine

A 25-POUND, two-for-one ply twister-winder machine, primarily developed for the plying of synthetic filament yarns to produce industrial cords, is being built by Deering Milliken Research Trust, Pendleton, S. C. The machine performs twisting at maximum uniformity and precision winding as a single-step composite operation, delivering a 25-30-pound knotless package finished with transfer tail and ready for packing and shipping, according to the manufacturer.

Major advantage of the unit is the elimination of the extra winding step which is necessary with the random-wound cord delivered on flange bobbins by the conventional twister. Another advantage claimed is the elimination of rethreading. Speed range of the unit is from 3,000-5,000 rpm. at the whorl, with a twist rate double that of the speed. Other specifications given include: denier range of finished cord, 2,000-50,000; twist range, 0.85-7.00 turns per inch; ply range, 2-120 individual ends; and production rate, 111 yards per minute (at 500 rpm. and 2.5 turns per inch).

Two machines, each with a separate motor drive, are mounted on a single base for economy of floor space. The Trust does not propose to continue building the machine and is conducting negotiations with textile machinery manufacturers to take over its construction.

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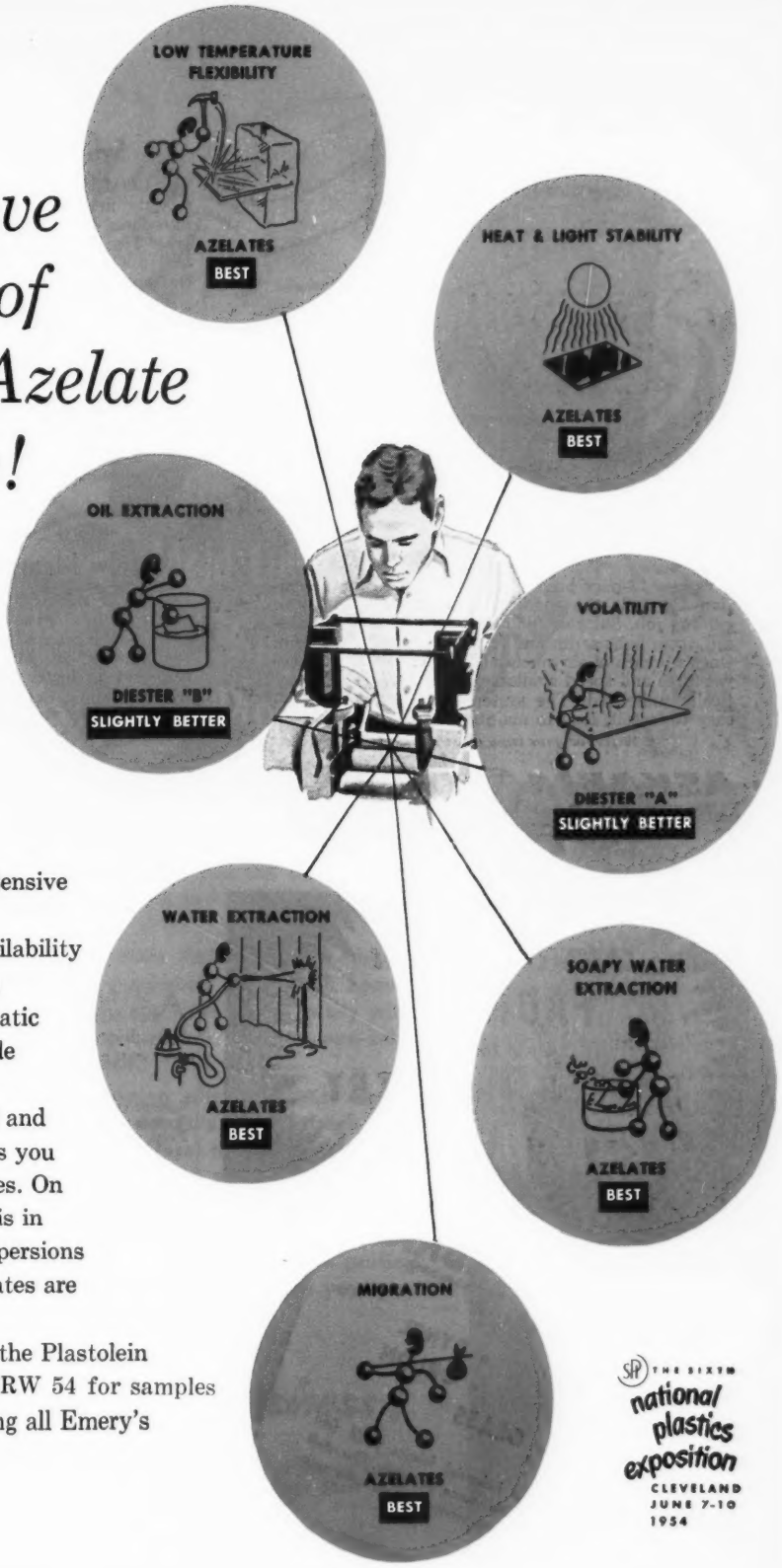

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New Materials

Synthetic Foam Rubber—Airfoam SL

A COMPLETELY synthetic foam material, claimed to be the first of its type produced in the United States, has been introduced by the research and development laboratories of Goodyear Tire & Rubber Co., Akron, O. Based on Chemigum SL, also a Goodyear product, Airfoam SL is represented as being resistant to fire and to deterioration from sunlight, oil, and grease.

The texture of the product can be varied from silky fine to rough, coarse material, according to the company, and compression can be varied from very soft to very firm. Airfoam SL, as compared to natural rubber latex foam, provides a product of higher compression with less weight, higher tensile strength, and similar porosity. Produced in all colors, including white, the new material is distinguishable from latex foam by its lustrous and sparkling appearance. It can be fabricated in much the same manner as regular airfoam, the company states.

Small samples of the new product are available from Goodyear.

New Monsanto Phenolic—Resinox 3001

A NEW mica-filled phenolic molding material, Resinox 3001, that has improved "moldability" and mechanical strength, has been announced by Monsanto Chemical Co., plastics division, Springfield, Mass. The "moldability" improvement is said to result in better mold release, better flow, faster cure, and fewer surface defects in the finished product. At the same time, impact, flexural, and tensile strengths have been increased 20% to provide greater resistance to cracking around inserts and other areas of high localized stress.

Resinox 3001 can be molded under the same conditions employed for other mica-filled phenolics and is claimed to have similar electrical properties, including excellent dielectric loss. The new material is recommended for use in radio tube sockets and bases, terminal strips, and electrical connectors and other components requiring good electrical and strength properties.

Three Amylamines Available

AMYLAMINE, diamylamine, and triamylamine are now available in semi-commercial quantities from Sharples Chemicals, Inc., 110 Widener Bldg., Philadelphia 7, Pa. The chemicals are water-white materials having the following properties:

	Amylamine	Diamylamine	Triamylamine
Specific gravity	0.76–0.78	0.77	0.78–0.79
Boiling range, °C.	87–115	175–202 (95%)	234–260
Flash point (open cup), °F.	65	160	210

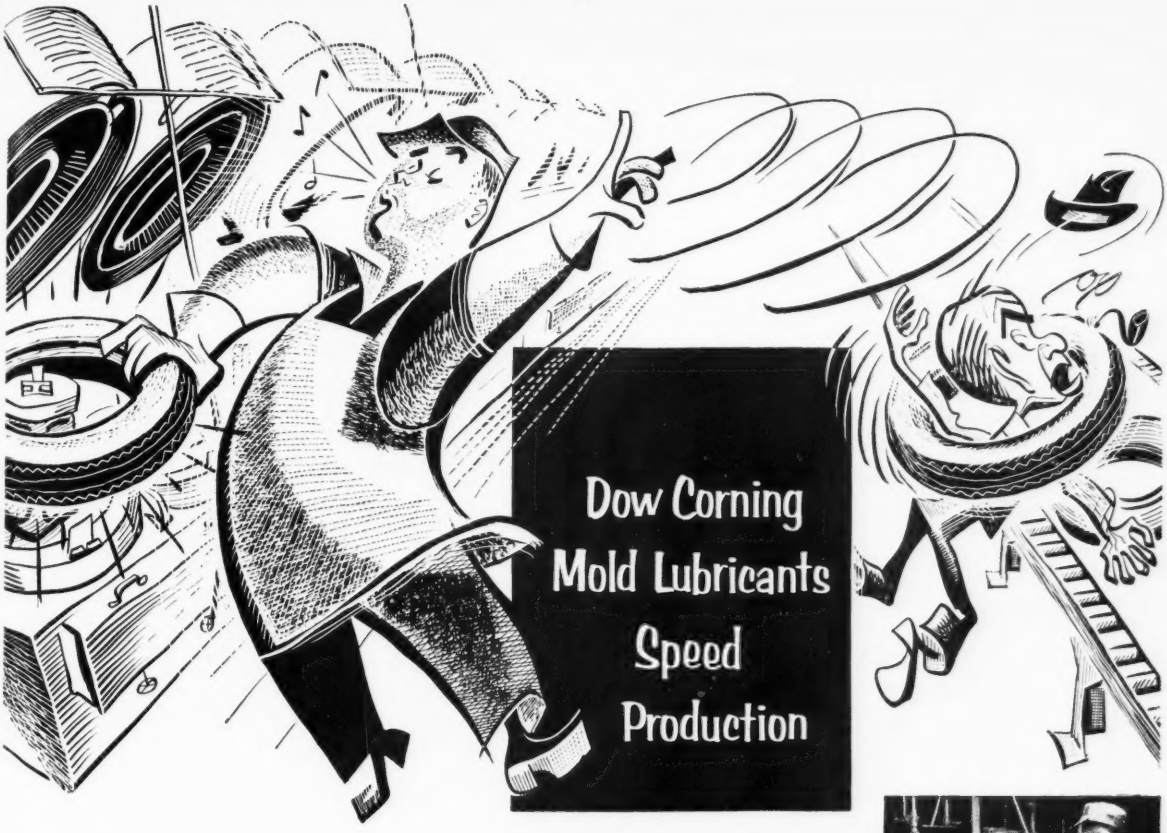
The products are said to be particularly useful in the preparation of oil-soluble products, including catalysts, corrosion inhibiters, surface-active agents, antioxidants, dyes, pharmaceuticals, and intermediates for the production of oil-soluble rubber.

Reinforcing Agent—Hi-Sil X303

HI-SIL X303, a hydrated silica of extremely fine ultimate particle size, has been announced by Columbia-Southern Chemical Corp., 420 Fort Duquesne Blvd., Pittsburgh 22, Pa., as a companion product to Hi-Sils 101 and 202. The new product is said to be an especially effective reinforcing agent for silicone rubber and to have potential value in floor waxes, thermal insulation, rigid vinyl, protective coatings, and other products.

A white powder, the new material has the following properties: specific gravity, 1.95; average particle size, 0.022-micron; surface area, 160 square meters per gram; pH of 5% aqueous suspension, 4.5; loss on ignition, 10%; silicon dioxide content, 88%; and impurities, 0.04% sodium chloride and 0.10% sodium sulfate.

In silicone rubber, Hi-Sil X303 is claimed to impart good reinforcement, low water absorption, and good processability. A typical formulation containing 45 parts Hi-Sil and 1.7 parts benzoyl peroxide per 100 parts silicone rubber has the following properties: tensile strength, 570 psi.; elongation, 280%; hardness, 62; 100% modulus, 130 psi.; and water absorption, 1.3% or 1.7 milligrams per square centimeter.



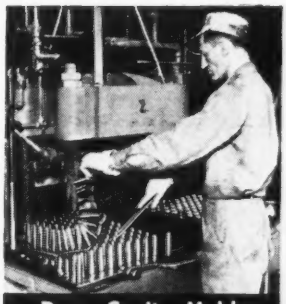
Dow Corning Mold Lubricants Speed Production

Production of salable moldings increases when you use Dow Corning silicone release agents. Rejects and scrap are reduced to the vanishing point.

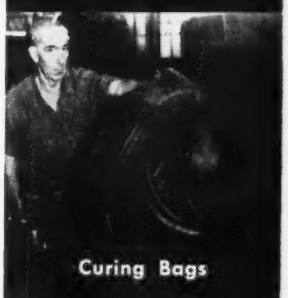
That's because silicone mold lubricants retain their "slip" at molding temperatures. Cavities fill quickly and completely, even with heavily loaded stocks. Complicated shapes and deep draws strip easily without tearing. And because only a light application is required, non-knits, fold-overs and loose tuck-unders disappear.

Molds stay cleaner longer, too. Dow Corning silicone release agents can't break down and leave carbonaceous deposits that roughen mold surfaces or discolor white or colored parts. Closer tolerances are maintained and even black moldings take on a higher, smoother gloss than ever before.

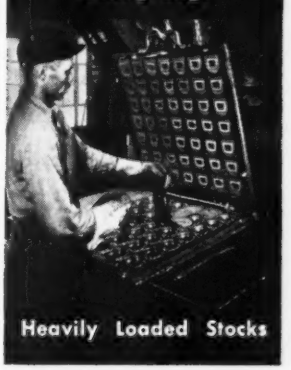
Join the steadily increasing number of molders who specify Dow Corning silicone mold release agents: fluid for green carcass, bead and parting line; emulsions for molds, mandrels and curing bags. When your production goes up and costs go down, you'll be glad you did.



Deep Cavity Molds



Curing Bags



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Parchment Liners and Separators

FOUR new types of Patapar Vegetable Parchment, suitable for use as liners and separator sheets for uncured rubber and rubber tape, and as backings for pressure-sensitive surfaces, have been announced by Paterson Parchment Paper Co., Bristol, Pa. Although differing in properties and appearance, the new papers are said to be low in cost, provide excellent release from many tacky surfaces, retain their releasing properties upon aging, have dense and fiber-free surfaces, and have high resistance to penetration or migration of rubber softeners and oils.

Patapar 35-22T, the lightest weight parchment, is a white paper about 0.0025-inch thick and weighing about 0.105-pound per square yard. This material is of particular interest as a wrapper for tacky substances and as a liner for fiberboard containers.

The remaining three Patapars are blue in color. Patapar 55-24T, about 0.004-inch thick and weighing about 0.17-pound per square yard, is the least flexible of the three papers and is recommended where rigidity of the backing material is desired. Patapar 55-26T, also 0.004-inch thick, but weighing about 0.185-pound per square yard, is flexible, has a rougher surface, and will release readily from uncured rubber compounds. The final material, Paptapar 55-27T, which is about 0.003-inch thick and weighs about 0.185-pound per square yard, is the most versatile of the new products. This paper has a smooth surface, is flexible, and provides the best releasing action.

All four parchments are available in either sheet or roll form in 60-inch widths, although rolls down to one inch in width can be furnished. Patapar 35-22T can be supplied in special widths up to 66 inches on volume orders.

New Silastic Stocks

TWO new Silastic silicone rubber stocks, 7-190 and 8-182, have been announced by Dow Corning Corp., Midland, Mich. The stocks are high durometer, low compression set materials suitable for use in oil seals, condenser bushings, and other molded parts. Properties given for the stocks are as follows:

	Silastic 7-190	Silastic 8-182
Color	Red	Gray
Plasticity (Williams), mils	150	150
Specific gravity	1.52	1.8
Hardness, Shore A	90	80
Tensile strength, psi.	650	600
Elongation, %	40	60
Brittle point, °F.	−80	−80
Compression set (22 hrs. at 150° C.), %	30	40
Water absorption, % vol. change:		
After 7 days at room temp.	1.5	1.0
70 hrs. at 212° F.	5.0	5.0
Dielectric strength, v/m.	500	500
Constant, at 10^6 cycles	3.28	4.1
Power factor, at 10^6 cycles	0.01	0.012

Silastic 7-190 is an excellent dielectric material that will withstand long exposure to elevated temperatures with little change in properties. It is said to be serviceable at temperature from −70 to +500° F. Since a mercury compound and cadmium oxide are used in 7-190 and 8-182, respectively, as low set additives, the stocks should not be used to fabricate parts that will be in contact with food or drugs.

Viscasil Silicone Fluids

VISCASIL FLUIDS, a new family of silicone fluids made by General Electric Co., Pittsfield, Mass., are said to be versatile enough to resist high temperatures and mechanical shear breakdown in automotive vibration dampers, yet to increase substantially the water repellency of the protective skin creams. Other suggested applications for the new materials include mold release agents for rubbers and resins, ice release agents for rubbers and metals, and medicine bases where they permit the ingredients to be released to the human system over a relatively long period of time.

The fluids are clear, water-white liquids containing no suspended matter and characterized by a relatively small change in viscosity over a wide temperature range; excellent heat stability; and chemical inertness. The fluids are said to be stable when exposed to temperatures of 300° F. for thousands of hours, have flash points on the order of 600° F., and to be soluble in hydrocarbons and higher alcohols. Viscasil Fluids are presently available in several viscosities from 1,000-100,000 centistokes, and higher viscosity grades will be made if warranted by demand.

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New Goods

Vinyl Rainwear Outfit

A RAINY day outfit designed to protect men from head to toe has been introduced by United States Rubber Co., Rockefeller Center, New York 20, N. Y. Called the "Commuter Outfit," the new product consists of a raincoat with cape back, a hat protector, and leggings, plus a pouch in which to carry the outfit.

Made of low-temperature, embossed plastic film with heat-sealed seams, the brown raincoat is available in small, medium, large, and extra-large sizes, in both regular and long lengths. The hat protector and leggings (the latter slip over the trousers and are held in place by a loop over the belt) are similarly constructed, but are supplied in only one size.

U. S. Rubber's New "Commuter Outfit"

Round Rubber Bands

TO FACILITATE sorting and handling, The B. F. Goodrich Co., Akron, O., is currently marketing rubber bands that are round rather than semi-elliptical in shape. Faster operation and reduced cost in applications involving use of these items have been reported to the manufacturer by firms testing the new product. The rubber bands, described as capable of retaining the round shape when packaged, are available to the customer in gray in sizes 10, 12, 14, and 16 at the same prices as bands of standard shape.

Liquid Rubber-Plastic Fabric Coatings

TWO new liquid materials, one designed for application to the underside of rugs to prevent slipping, and the other for application to old fabrics to rejuvenate their appearance, have been introduced by Adhesive Products Corp., New York, N. Y.

The liquid designed for rugs, called Griptex, also prevents fraying and may be used for repair work without sewing, according to the company. Griptex is applied by brush or spray and quickly dries to a strong rubbery film that anchors itself to the rugs. Permanently flexible, the coating will not mar floors and will sustain washing and dry cleaning, the manufacturer further states.

The fabric rejuvenator, Nu-Fab, is a paint intended to add new luster and life to worn and faded fabrics, from upholstered furniture and baby mattresses to auto tops and beach accessories. Flexible when dry and a retardant to fire, dry rot, mildew, and moth consumption, the new material is represented as a paint which seals small holes, waterproofs, and adheres patches. Five colors of the paint plus black and white are available, all of which dry in 30 minutes and are capable of washing with boiling water.

Teflon "Super-Thin" V-Rings

SOLID Teflon V-rings with cross-sections as small as 0.015-inch are being made by Reid Enterprises, Los Angeles, Calif., for use in pumps, valves, and other types of machines which require packing. The manufacturer claims that the resiliency of the V-rings is so great that even low pressures exert a flattening action on the cone-shaped segments.

Besides being smaller and lighter than previous Teflon rings, the new products are more economical than their predecessors by two-thirds, according to Reid. The resiliency of the units is such that less pressure is needed to cause flexing than is required for deformation. Suitable for temperature service from —150 to 550° F., the "Super-Thin" rings also feature the chemically inert and slippery surface properties of the Teflon that are so necessary for packing applications.

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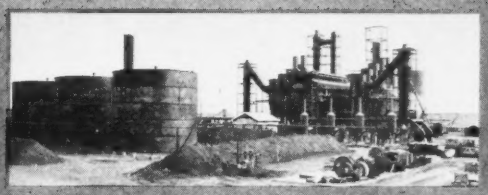

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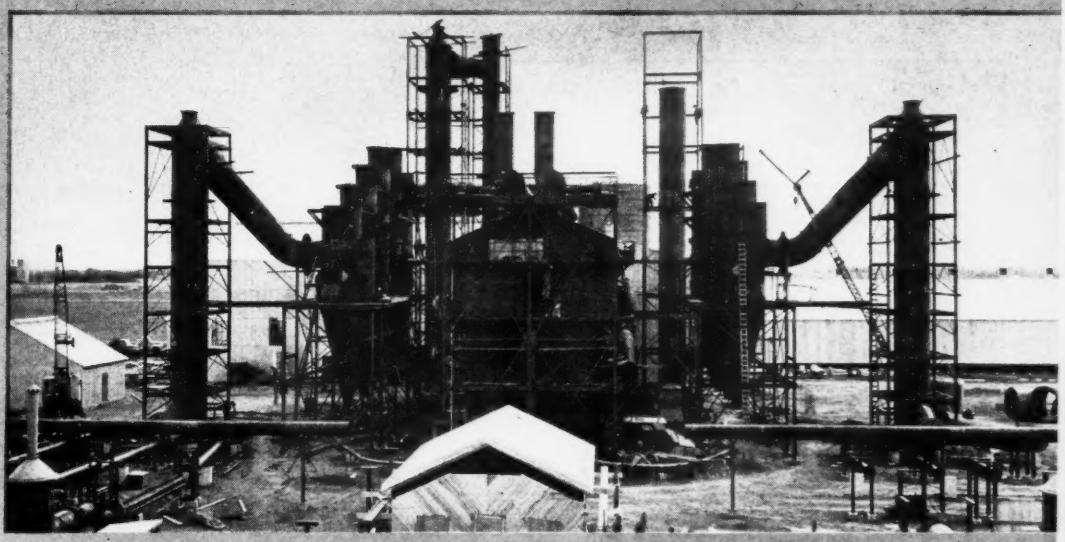

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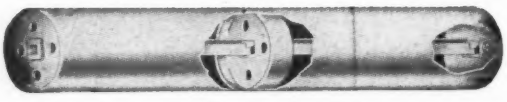

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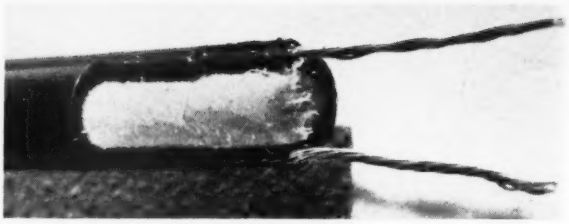

Cut-Away View of Television Cable with Polyethylene Jacket and Cellular Core

Polyethylene Insulated TV Wire

A NEW UHF and VHF television lead-in wire, featuring Bakelite cellular and solid polyethylene insulation and said to reduce picture-distorting electrical line losses, has been developed by Belden Mfg. Co., Chicago, Ill. The product has a cellular polyethylene core wrapped in a durable, solid polyethylene jacket in which are embedded twin pair lead-in wires, and is designed to meet the problems of high-frequency transmission.

The cellular core has a specific gravity and dielectric constant less than that of the jacket and is filled with tiny unconnected cells containing an inert gas. The thick jacket protects the cable against abrasion, water, weather, and mechanical damage. The parallel conductors are annealed copper-covered steel strands said to have 49% greater resistance to breaking from flexing or stretching than do all-copper conductors. The cable can be clamped tightly in stand-off insulators without crushing, and the polyethylene insulation makes it unnecessary to seal off the cable ends in order to prevent moisture absorption.

Improved Bicycle Tire

THE Wingfoot, a new bike tire with a cross-section size intermediate between that of the conventional balloon (2.125 inches) and the lightweight (1.375 inches) models, is being manufactured by Goodyear Tire & Rubber Co., Akron, O. With this new size of 1.75 inches, the tire is reported to combine the sturdiness feature of the large tire with the pedaling ease of the popular lightweight unit.

The new product is made in three diameters for 20-, 24-, and 26-inch bicycles which have a 2.125-inch rim. The tire's tread, sidewall, and fabric construction are similar to the company's lightweight units. Cost of the Wingfoot is slightly greater than for standard balloon models.

Latex Non-Skid Coating for Rugs—JLG-988

JLG-988, a synthetic latex designed for application to rug backing to provide a non-slip surface, has been developed by Angier Products, Inc., Cambridge, Mass. Formulated to be resistant to aging and washing, the new product is capable of application by means of a roll or knife coater.

Wading Pools of Krene Vinyl Plastic

TWO manufacturers recently introduced family wading pools which feature the use of Bakelite's Krene vinyl plastic film to contain the water. Bilnor Corp., Brooklyn, N. Y., produces four models, 8½-20 feet in diameter; while Doughboy Industries, Inc., New Richmond, Wis., manufactures three pool sizes ranging from 8½ to 18 feet in diameter. Height of these products measures three feet.

The Bilnor pools employ a plastic-coated steel mesh wall to support the sidewall of the flexible Krene liner, and an inflatable vinyl bumper to protect swimmers from the top of the sidewall. Doughboy also uses the steel wall, but only on its largest model; with the smaller sized pools, ribbed supporting walls of wooden slats are employed. The Doughboy models also have the inflatable bumpers for protection.

Assembly of these units requires only a level section of ground of appropriate size. The Krene liner, consisting of laminated plys of vinyl sheeting, is spread on the ground with its peripheral material against the inside and over the top of the wall. Up to 7,000 gallons of water can be contained in the largest, 20-foot pool.

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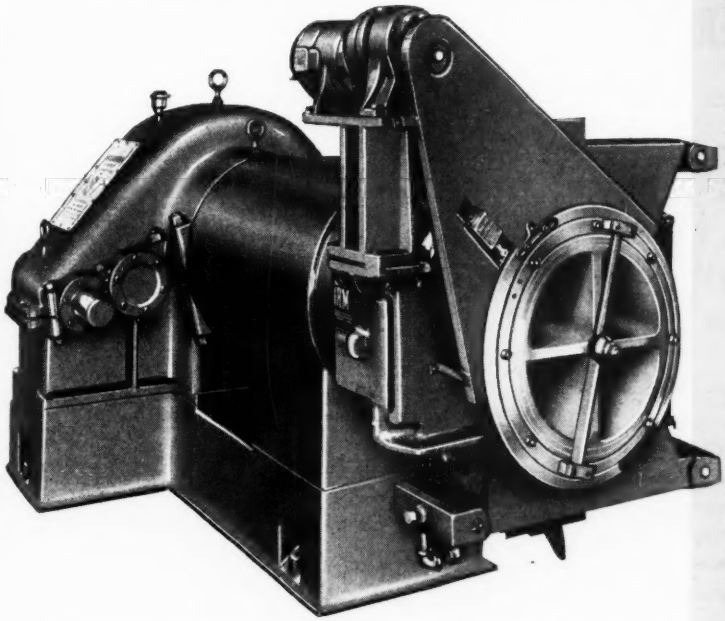
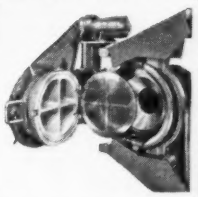


Advanced design and engineering features like these are only a few of the many reasons which have made NRM Rubber Strainers the "standard" of the industry. Plant owners appreciate, too, their space-saving compactness, installation ease and operating simplicity.

Our new data bulletin on NRM Rubber Strainers fully explains design, construction and operating features and advantages. A postcard brings it to you without delay. See for yourself why rubber goods manufacturers the world over rely on NRM Strainers for trouble-free *sustained* high production, at minimum maintenance cost.

QUICK-OPENING HEADS

Merely flip a valve and air-operated clamps are *instantly* released and the NRM head can be swung open. This compares with 5 to 10 minutes or longer required to open other types of heads. Screen-changing time is reduced to an absolute minimum.



HINGED STRAINER PLATES

NRM Strainer Plates are hinged directly on the head assembly to provide quick access to head interiors. Cleaning of both plate and the head cavities is thus made easier and faster.

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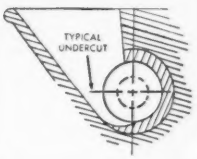
Offset and undercut, NRM Feed Boxes provide uniform, maximum stuffing of the cylinder. Whether hand or strip fed, the undercut enables the screw to "pull" steadily, preventing voids in the cylinder and providing maximum thru-put.



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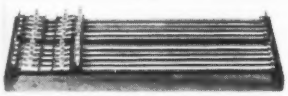

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BOOK REVIEWS

"Principles of Polymer Chemistry." Paul J. Flory. Cornell University Press, Ithaca, N. Y. Cloth, 6 by 9¼ inches, 688 pages. Price, $8.50.

In view of the rapid and continuing growth of the field of polymer chemistry, the author has made no attempt at an extensive treatment of the field, but has limited his subject to fundamental principles that have gained recognition during the course of research work. As such, experimental results are given mention only for illustrative purposes, as are descriptions of properties of specific polymers. While familiarity with college chemistry, physics, and calculus is needed for proper understanding of the text, no previous knowledge of polymers is required, and the book will be of great value to beginners in the field. At the same time the extensive bibliography lists appended to each chapter will be of interest to experienced investigators.

The book comprises 14 chapters, of which the first two are introductory; one reviews historical developments, and the second sets forth essential definitions and elementary concepts. The next three chapters deal with polymerization and copolymerization reaction mechanisms and kinetics. Chapters six through nine cover the broad field of polymer constitution, and the final five chapters deal with molecular configuration and associated properties of polymers and their solutions. Appendices include a glossary of principal symbols and both author and subject indices.

"Methoden der Organischen Chemie." Houben-Weyl. "Analytische Methoden." Volume II. Fourth completely revised edition. 1953. Edited by Eugene Muller with special collaboration of O. Bayer, H. Meerwein, and K. Ziegler. Publishers, Georg Thieme Verlag, Stuttgart, Germany. Agents for the U.S.A., Grune & Stratton, Inc., 381 Fourth Ave., New York 16, N. Y. Cloth, 7½ by 10¼ inches, 1094 pages, 252 illustrations. Price 139 DM; 125. 10 DM if ordered in advance of publication.

In the June, 1953, issue of India RUBBER WORLD was reviewed Volume VIII of the extensive new edition of Houben-Weyl's "Methods of Organic Chemistry." The individual volumes of the work (which, it seems, may run to 15 volumes) are issued as they become ready, without observation of any fixed order, and Volume VIII was the first to appear. Now Volume II has come off the press.

Divided into two parts, it deals with the most important analytical methods of organic chemistry. In Part I, which accounts for more than two-thirds of the material in the volume, Chapter I treats of quantitative and qualitative organic elementary analysis. Analytical determinations of the most important functional atomic groups and classes of compounds are dealt with at some length in a longer, second chapter. Here we note that space considerations made it necessary to reserve for discussion in a future volume methods for certain compounds and also for halogen-containing functional groups. A feature of this section is that in addition to the description of methods, wherever possible, sources of error, limits of error, range of application, and interference by other substances are also considered.

Incidentally, the methods are described in such detail that the analyst can work directly from the indications given.

Part II includes five chapters devoted, respectively, to gasometric and gas analysis methods; determination of melting, freezing, boiling, and condensation temperatures; thermal analysis and determination of organic molecular combinations; chromatographic analysis; and analysis of solvent mixtures.

At the beginning of the volume are a list of periodicals and a list of the abbreviations used; bibliographies are appended to various sections. From notes at the beginning of each chapter it is seen that in most cases the literature up to and often through 1952 has been considered. Each chapter is preceded by a detailed table of contents, and there are indices of authors and subjects at the end of the book.

"Annual Report (1953) of the Armour Research Foundation." Armour Research Foundation of Illinois Institute of Technology, Chicago 16, Ill. 66 pages. The research work being done by the Foundation in various scientific fields is described in the report. Such work in the rubber and plastics fields include preliminary evaluation of plasticizers for vinyl resins, evaluation of petroleum resins in rubber compounding, gasket materials evaluation, and others.

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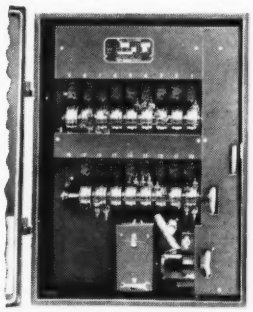

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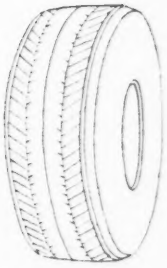

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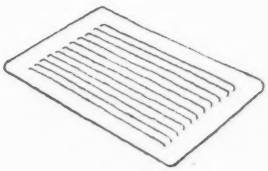

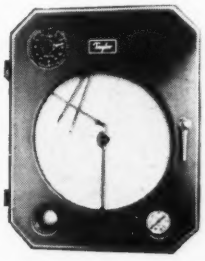

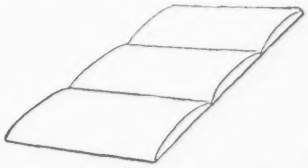

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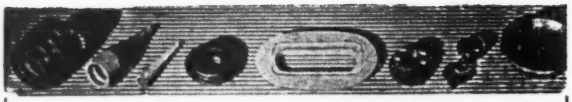

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NEW PUBLICATIONS

"Indonex Plasticizers in Oil Resistant GR-S Compounds." Circular 13-48, February 1, 1954. Indoil Chemical Co., 910 S. Michigan Ave., Chicago 80, Ill. 6 pages. One of the company's line of plasticizers, No. 637½, was incorporated into GR-S 1708, and the resulting physical properties of the rubber compounds, as well as a description of the properties of the plasticizer, are given in this bulletin.

"Hycar Technical Newsletter." Vol. 3, No. 3. B. F. Goodrich Chemical Co., Rose Bldg., Cleveland 15, O. 6 pages. Contained in this newsletter are material on the effect of proposed reference fuels on Hycar compounds; a new designation for Hycar 1012X41 (a liquid nitrile polymer now a production item); and a chart listing Hycar dry rubbers, their physical properties, and suggested uses.

"Neoprene Notebook." No. 58. E. I. du Pont de Nemours & Co., Inc., Wilmington, Del. 8 pages. The fifth in a series of articles on "The Language of Rubber," on the load carrying capacity of rubber, including the static and dynamic modulus testing methods, is contained in this illustrated publication. Other articles cover the use of neoprene putty to seal construction joints in hollow concrete foundations; a system of conveyor belting for handling bananas; and information on a new coolant tube, a diaphragm valve, and a measuring wheel.

"Portable Potentiometer, Indicators and Resistance Thermometers." Bulletin A-303-1. The Foxboro Co., Foxboro, Mass. 8 pages. The specifications and construction features of these instruments are described and illustrated in this booklet.

"Reinforcement of Neoprene with Plio-Tuf Resins." Techni-Guide PT-100-4. Goodyear Tire & Rubber Co., Inc., Akron 16, O. 10 pages. Detailed information is presented on the properties, processing, compounding, forming, and applications of neoprene-Plio-Tuf blends containing varying amounts of resin.

"Witcarb Fillers for Polyester Resins." Technical Service Bulletin W-1. Witco Chemical Co., 260 Madison Ave., New York 16, N. Y. 4 pages. The practical advantages to be gained by incorporating precipitated calcium carbonates as inert fillers in polyester resins used for molding or casting products are detailed in this bulletin along with typical physical properties of resulting resins and the specifications and physical properties of the Witcarbs themselves.

"The Resin Route: A Story of Diversification." By William O'Neil. The General Tire & Rubber Co., Akron, O. 8 pages. This pamphlet describes how resins, developed by the company's research laboratories, led down the diversified route from rubber to plastics, chemicals, and rockets.

"Fumaric Acid in Coating and Polyester Resins." Technical Bulletin No. 0-115. Monsanto Chemical Co., St. Louis 1, Mo. 10 pages. The use of this acid to improve alkyd resins, polyester resins, and other substances is described in this bulletin, with processing logs and other detailed data.

"B. F. Goodrich Mats and Matting." Catalog 6100. The B. F. Goodrich Co., Akron, O. 4 pages. The various types of mats and matting, including Koroseal runner matting, are described with specifications and illustrations in this catalog insert.

Publications of Dow Corning Corp., Midland, Mich.

"Silastic Newsletter." Vol. II, No. 1, April, 1954. 14 pages. This Newsletter is the anniversary review issue of the publication and contains all the important data presented in the first six issues. The information is separated into three groups: applications, processing, and properties of Silastic.

"Silastic Facts." 9-334. 4 pages. This technical data sheet is a compilation of 30 of the most popular Silastic stocks and pastes with their general characteristics, serviceable temperature range, typical applications, and fabrication and application methods. Also included are typical properties of these stocks when cured as recommended by the company.

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"Process Equipment." Bulletin 2439. Blaw-Knox Co., Pittsburgh 22, Pa. 12 pages. This bulletin describes equipment made by the company such as reaction vessels, quick-opening doors, kettles, vulcanizers, stuffing boxes, and complete resin plants.

"Bi-Monthly Supplement to Lists of Accident Equipment, Automotive Equipment, Burglary Protection Equipment, Electrical Equipment, Hazardous Location Electrical Equipment, Fire Protection Equipment, Gas and Oil Equipment." October, 1953. Underwriters' Laboratories, Inc., Chicago, Ill. 96 pages. **"Motor Truck Facts."** 1953 edition. Automobile Manufacturers Association, Detroit, Mich. 56 pages. **"1954 Year Book."** The Tire & Rim Association, Inc., Akron, O. $3.50. 176 pages.

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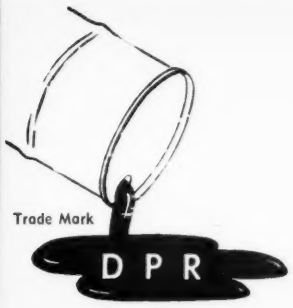

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MARKET REVIEWS

RUBBER

SHARPLY rising prices for both physical and futures rubber featured the market during the period from March 16 to April 15. The major cause for the price advance was the tense Indo-China situation, but the effect of a pick-up in domestic rubber goods manufacturing activity, led by the automotive industry demand for tires, also made itself felt on the market.

The sharpest price rise took place at the end of March as consumers and dealers bought heavily on both the spot market and the Commodity Exchange. During the first half of April prices fluctuated widely as profit-taking by commission houses and reactions to the advance served to depress the market briefly. The immediate outlook is for a firm market and, possibly, further price increases, pending an easing of the Indo-China war.

NEW YORK SPOT MARKET
WEEK-END CLOSING PRICES

	Jan. 30	Feb. 27	Mar. 20	Mar. 27	Apr. 3	Apr. 10
R. S. S.: #1	20.25	19.88	20.50	20.50	22.25	22.13
2	19.88	19.50	20.25	20.25	21.88	21.88
3	19.63	19.38	20.13	20.13	21.50	21.50
Latex Crepe						
#1 Thick	24.38	23.88	24.13	24.50	25.50	25.75
Thin	22.25	22.13	22.75	23.25	23.88	24.38
#3 Amber						
Blankets	17.38	17.50	18.63	18.88	20.38	20.50
Thin Brown Crepe	16.63	16.50	17.38	17.63	19.25	19.13
Flat Bark	15.25	15.00	15.25	15.25	16.00	16.13

No. 1 Ribbed Smoked Sheets started the period at a low of 20.25¢, reached a high of 22.25¢ on April 2, and closed at 22.00¢ on April 15. Other grades showed corresponding price movements. March monthly average spot prices for certain grades were as follows: #1 R.S.S., 20.22¢; #3 R.S.S., 19.83¢; #3 Amber Blankets, 18.31¢; and Flat Bark, 15.10¢.

COMMODITY EXCHANGE
WEEK-END CLOSING PRICES

Futures	Jan. 30	Feb. 27	Mar. 20	Mar. 27	Apr. 3	Apr. 10
July	20.15	19.65	20.15	20.33	22.20	22.25
Sept.	20.20	19.75	20.10	20.30	22.20	22.30
Dec.	20.15	19.70	20.10	20.30	22.35	22.70
Mar. '55	20.15	19.75	20.15	20.49	22.45	22.65
May	.....	.....	20.15	20.50	22.45	22.65
Total weekly sales, tons	2,640	1,110	2,600	3,570	9,470	12,150

July futures started the period at a low of 19.95¢, climbed to 22.20¢ on April 2, fell back, then rose to a high of 22.25¢ on April 9, and ended the period at 22.24¢.

Sales during the second half of March were 9,630 tons, making a total for the month of 13,250 tons, the highest figure since June, 1952. Reflecting the marked improvement in business, the sales total for the first half of April was 22,630 tons. On April 9 a total of 3,420 tons of rubber was sold to reach a new daily high since the postwar reopening of the Exchange.

Latex

A CONSIDERABLE firming of natural latex prices took place during the second half of the period from March 16 to April 15. While some of this firmness could be attributed to higher crude rubber prices, improved demand by domestic consumers also played an important part in the rising market.

Despite statistical indications, the latex market does not reflect a higher inventory position. Supplies, in general, have been adequate although some occasional pinches have been reported by importers. The effects of the wintering season in the Far East appear to have been dissipated in the domestic market, although wintering in Liberia is still being felt to some extent.

The outlook for latex during the latter half of this year is somewhat uncertain. Some observers feel that rising demand will create a tight supply situation; while others see a mild oversupply this year, followed by a shortage next year when new foam production facilities go into operation.

Final January and preliminary February domestic statistics for natural and synthetic rubber latices are given in the following table:

(All Figures in Long Tons, Dry Weight)

	Production	Imports	Consumption	Month-End Stocks
Natural latex				
Jan.	0	5,396	5,882	12,375
Feb.*	0	6,000	5,437	13,001
GR-S latices				
Jan.	4,089	0	3,475	5,001
Feb.*	3,928	0	3,565	5,424
Neoprene latex				
Jan.	592	0	615	1,019
Feb.*	742	0	537	949
Nitrile latices				
Jan.	471	0	275	703
Feb.*	375	0	266	674

*Preliminary

SCRAP RUBBER

A SLIGHTLY improved tone was noted in the scrap rubber market during the period from March 16 to April 15. Scrap orders from reclaimers for delivery during April were reported to be appreciably higher than in the preceding month. Most of the demand was concentrated in mixed and S.A.G. tires, No. 3 peelings, and tire buffings. Demand for most scrap tubes continued to lag despite an easing of prices for certain grades.

As for price movements, S.A.G. truck tires dropped from $15 to $14 per ton at Akron; No. 3 peelings rose $1.00-1.50 per ton in the East; mixed auto tubes rose 0.25¢ per pound at Akron; red tubes dropped from 9.00 to 8.00¢ per pound at Akron and in the East; and Butyl tubes declined from 1.75 to 1.63¢ per pound in the East.

Following are dealers' selling prices for scrap rubber, in carload lots, delivered to mills at the points indicated:

	Eastern Points	Akron, O.
	(Per Net Ton)	
Mixed auto tires	$11.00	$12.00
S. A. G. auto tires	Nom.	13.00
Truck tires	Nom.	14.00
Peelings, No. 1	40.00/41.00	40.00/42.00
2	Nom.	24.00
3	15.50	Nom.
Tire buffing	18.00/20.00	16.00/17.00
	(¢ per Lb.)	
Auto tubes, mixed	2.50	2.75
Black	4.25	4.50
Red	8.00	8.00
Butyl	1.63	2.00

RECLAIMED RUBBER

A CONSIDERABLE improvement in demand for reclaimed rubber became evident during the period from March 16 to April 15. Most of this improvement came during the first half of April, and indications were that reclaim sales totals for April would far surpass those of the preceding month. The increased demand for reclaim resulted from the long-awaited pick-up in activity of the automotive industry. Because of the close interrelation of these industries, forecasting the reclaim market is a hazardous undertaking, but the outlook for the next few months is encouraging.

Final January and preliminary February statistics on the domestic reclaimed rubber industry are now available. January figures, in long tons, were: production, 19,960; imports, 66; consumption, 19,114; exports, 912; and month-end stocks, 31,805. Preliminary statistics for February, in long tons, were: production, 20,969; imports, 161; consumption, 19,514; exports, 972; and month-end stocks, 32,855.

There were no changes in reclaimed rubber prices during the period, and current prices follow:

Reclaimed Rubber Prices

	Lb.
Whole tire: first line	$0.10
Fourth line	.0875
Inner tube: black	.15
Red	.21
Butyl	.125
Pure gum, light colored	.23
Mechanical, light colored	.135

The above list includes those items or classes only that determine the price basis of all derivative reclaim grades. Every manufacturer produces a variety of special reclaims in each general group separately featuring characteristic properties of quality, workability, and gravity at special prices.

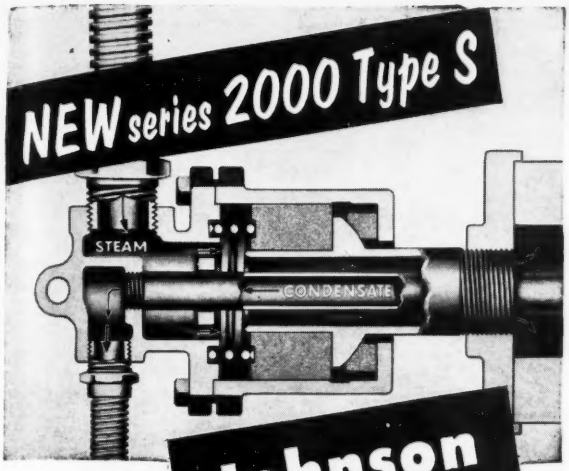
COTTON FABRICS

TRADING in wide industrial fabrics during the period from March 16 to April 16 was generally confined to small, fill-in lots for immediate delivery. Some moderate to fair sized lots of certain wide drill, headlining, and broken twill constructions were made for May delivery. The continued lag in demand for most fabrics resulted in a further easing of prices, although duck and chafer prices held firm.

Toward the end of the period an improved demand began to become evident for wide sateens, broken twilis, and drills as the coating industry started to place orders for May delivery. In view of reduced production by mills and prospects of an upswing in demand by the automotive industry, fabric coaters anticipated a delivery squeeze and were trying to improve their inventory position.

Cotton Fabrics

Drills		
59-inch 1.85-yd.	yd.	$0.355
2.25-yd.		.305
Ducks		
38-inch 1.78-yd. S. F.	yd.	nom.
2.00-yd. D. F.		$0.30⅝
51.5-inch. 1.35-yd. S. F.		.46⅝
Hose and belting		.64



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Osnaburgs

40-inch 2.11-yd	yd.	.24
3.65-yd		.155

Raincoat Fabrics

Printcloth, 38½-inch, 64x60	yd.	.1325	$0.135
Sheeting, 48-inch, 4.17-yd		.20	
52-inch, 3.85-yd		.22	

Chafer Fabrics

14.30-oz./sq. yd. Pl.	lb.	.71	
11.65-oz./sq. yd. S		.63	
10.80-oz./sq. yd. S		.6675	
8.9-oz./sq. yd. S		.68	

Other Fabrics

Headlining, 59-inch, 1.65-yd., 2-ply	yd.	.4675	.47
64-inch, 1.25-yd., 2-ply		.60	
Sateens, 53-inch, 1.32-yd		.54	
58-inch, 1.21-yd		.59	

RAYON

SHIPMENTS of rayon by domestic producers during March totaled 90,800,000 pounds, 12½% higher than in the preceding month. March production was 87,700,000 pounds, 15½% above the February figure, and month-end producers' stocks were 103,700,000 pounds or 3% below those of February. March statistics for rayon high-tenacity yarn were: calculated production, 33,200,000 pounds (10% higher than in February); shipments, 32,100,000 pounds (5% above the February figure); and month-end stocks, 16,000,000 pounds (about 7% above February stocks).

Domestic production of all types of tire cord and fabric in 1953 amounted to 520,000,000 pounds. This total consisted of 16,000,000 pounds of cotton tire cord and fabric; 351,000,000 pounds of woven rayon tire fabric; 78,000,000 pounds of non-woven rayon tire cord; 19,000,000 pounds of nylon cord and fabric; and 56,000,000 pounds of cotton chafer fabric. Exports during 1953 of tire cord and fuel cell fabrics amounted to 10,167,000 pounds, valued at $9,261,000.

There were no changes in rayon tire yarn and fabric prices during the period from March 16 to April 15, and current prices follow:

Rayon Prices

Tire Yarns

1100/ 480	$0.26	$0.63
1100/ 490		.62
1150/ 490		.62
1165/ 480		.63
1650/ 720		.61
1650/ 980		.61
1820/ 980		.61
2200/ 960		.60
2200/ 980		.60
2200/1466		.67
4400/2934		.63

Tire Fabrics

1100/490/2		.72
1650/980/2	.650	.73
2200/980/2		.685

Financial

(*Continued from page 258*)

Plymouth Rubber Co., Canton, Mass. Year ended November 30, 1953: net income, $225,164, equal to 25¢ a share, contrasted with net loss of $21,416 a year earlier.

National Automotive Fibres, Inc., Trenton, N. J. For 1953: net profit, $3,231,040, equal to $3.24 a share, contrasted with $2,053,346, or $2.06 a share, the year before.

The Mohawk Rubber Co., Akron, O. Year ended December 31, 1953: net earnings, $413,321, equal to $2.92 each on 141,638 common shares, contrasted with $683,658, or $4.83 a share, in the preceding year; net sales, $16,263,782, against $19,189,795; current assets, $4,110,628; current liabilities, $1,054,639.

Dunlop Tire & Rubber Goods Co., Ltd., Toronto, Ont., Canada. For 1953: net profit, $299,265, compared with $315,000 in 1952; income taxes, $217,000, against $279,000; current assets, $10,931,529, current liabilities, $2,975,181, against $8,873,562 and $1,737,572, respectively, on December 31, 1952.

Mansfield Tire & Rubber Co., Mansfield, O. For 1953: net earnings, $927,005, equal to $1.68 a common share, contrasted with $1,330,099, or $2.41 a share, the year before; net sales, $59,078,904, against $55,551,843.

Johnson & Johnson, New Brunswick, N. J., and domestic subsidiaries. Year ended December 31, 1953: net income, $8,805,000, equal to $4.19 each on 2,100,366 common shares, compared with $7,997,834, or $3.82 each on 2,092,377 shares, the year before; sales, $197,605,000, against $190,262,048; federal income and excess profits taxes, $10,773,000, against $12,508,111.

(*Concluded on page 286*)

United States Rubber Statistics—January, 1954

(All Figures in Long Tons, Dry Weight)

	New Supply			Distribution		
	Production	Imports	Total	Consumption	Exports	Month-End Stocks
Natural rubber and latex, total	0	47,140	47,140	46,960	648	112,679
Rubber, total	0	41,744	41,744	41,078	648	100,304
Latex, total	0	5,396	5,396	5,882	0	12,375
Synthetic rubbers, total	*49,023 †8,276	750	58,049	50,173	1,347	180,839
GR-S types‡	*43,524 †143	710	44,377	*37,707 †982	618	138,692
Butyl	*5,499	40	5,539	*5,390 †48	0	24,733
Neoprene‡	†6,513	0	6,513	4,774	434	13,065
Nitrile types‡	†1,620	0	1,620	1,272	295	4,349
Natural rubber and latex, and synthetic rubbers, total	57,299	47,890	105,189	97,133	1,995	293,518
Reclaimed rubber, total	19,960	66	20,026	19,114	912	31,865
GRAND TOTALS	77,259	47,956	125,215	116,247	2,907	325,383

*Government plant production.
†Private plant production.
‡Includes latices.
SOURCE: Chemical & Rubber Division, BDSA, United States Department of Commerce, Washington, D. C.

Estimated Pneumatic Casings, Tubes, Camelback Shipments, Production, Inventory, February, January, 1954; First Two Months, 1954, 1953

	Original Equipment	Replacement	Export	Total	Production	Inventory
Passenger casings						
Feb. 1954	2,322,984	3,001,131	59,761	5,383,876	5,952,480	12,834,883
Change from previous month				−10.06%	+13.35%	+4.53%
Jan. 1954	2,548,899	3,378,333	58,681	5,985,913	5,251,403	12,279,042
First 2 mos., 1954	4,871,883	6,379,464	118,442	11,369,789	11,203,883	12,834,883
1953	5,327,309	7,076,530	61,352	12,465,191	13,671,495	12,310,653
Truck and Bus Casings						
Feb. 1954	310,769	556,161	56,912	923,842	1,089,301	2,876,813
Change from previous month				−9.05%	+3.93%	+6.64%
Jan. 1954	341,949	614,964	58,836	1,015,749	1,048,082	2,697,796
First 2 mos., 1954	652,718	1,171,125	115,748	1,939,591	2,137,383	2,876,813
1953	939,357	1,612,609	107,699	2,659,665	2,802,945	2,984,510
Total Automotive Casings						
Feb. 1954	2,633,753	3,557,292	116,673	6,307,718	7,041,781	15,711,696
Change from previous month				−9.91%	+11.78%	+4.91%
Jan. 1954	2,890,848	3,993,297	117,517	7,001,662	6,299,485	14,976,838
First 2 months, 1954	5,524,601	7,550,589	234,190	13,309,380	13,341,266	15,711,696
1953	6,266,666	8,689,139	169,051	15,124,856	16,474,440	15,295,163
Tractor—Implement Casings						
Feb. 1954	156,102	120,981	5,550	282,633	242,889	722,947
Change from previous month				+4.83%	+19.22%	−4.78%
Jan. 1954	156,917	108,208	4,482	269,607	203,726	759,223
First 2 months, 1954	313,019	229,189	10,032	552,240	446,615	722,947
1953	570,930	263,796	8,229	842,955	818,076	850,862
Passenger, Motorcycle, Truck and Bus Inner Tubes						
Feb. 1954	2,635,520	2,908,033	73,701	5,617,254	5,896,024	10,448,121
Change from previous month				−17.81%	+9.28%	+3.37%
Jan. 1954	2,883,946	3,892,438	57,613	6,833,997	5,395,155	10,107,488
First 2 months, 1954	5,519,466	6,800,471	131,314	12,451,251	11,291,179	10,448,121
1953	6,273,550	7,607,424	99,665	13,980,639	12,692,373	10,423,136
Camelback (Lbs.)						
Feb. 1954	—	18,645,912	564,163	19,210,075	20,095,430	27,268,002
Change from previous month				−9.16%	−8.14%	+1.95%
Jan. 1954	—	20,497,860	649,939	21,147,799	21,876,648	26,745,563
First 2 months, 1954	—	39,143,772	1,214,102	40,357,874	41,972,078	27,268,002
1953	—	43,986,880	1,677,760	45,664,640	50,229,760	27,496,000

NOTE: Cumulative data on this report include adjustments made in prior months.
SOURCE: The Rubber Manufacturers Association, Inc., 444 Madison Ave., New York 22, N. Y.

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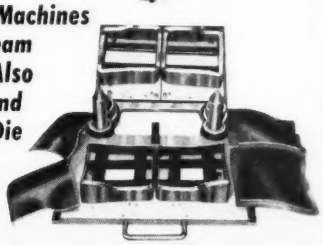

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U. S. Imports, Exports, and Reexports of Crude and Manufactured Rubber

Exports of Domestic Merchandise

	December, 1953 Quantity	Value
UNMANUFACTURED, LBS.		
Chicle and chewing gum bases	384,185	$154,278
Balata, gutta percha, etc.	500	1,175
Synthetic rubbers		
GR-S types	1,774,226	551,445
Butyl	11,065	2,702
Neoprene	3,171,834	1,428,430
Nitrile type	928,409	477,797
Other	135,058	114,340
Reclaimed rubber	2,308,623	203,219
Scrap rubber	4,139,498	97,621
TOTALS	12,853,398	$3,031,007
MANUFACTURED		
Rubber cement ..... gals.	65,905	$135,215
And rubberized fabric ..... sq. yds.	217,863	201,082
Clothing	.....	134,950
Footwear		
Boots and shoes ..... prs.	33,401	85,219
Rubber-soled canvas shoes ..... prs.	9,456	23,495
Heels ..... doz. prs.	53,217	61,662
Soles, soling, toplift sheets ..... lbs.	802,658	207,592
Gloves and mittens ..... doz. prs.	21,804	74,086
Drug sundries	.....	171,048
Toys, balls, novelties	.....	59,921
Hard rubber goods		
Battery boxes ..... no.	29,838	69,277
Other electrical goods ..... lbs.	181,425	113,765
Other	.....	36,670
Rubber tires and casings		
Truck and bus ..... no.	66,170	3,348,756
Auto and motorcycle ..... no.	70,467	965,188
Aircraft ..... no.	6,600	283,327
Off-the-road ..... no.	13,156	1,319,762
Farm tractor ..... no.	4,245	158,151
Implement ..... no.	2,032	62,350
Other ..... no.	9,532	41,456
Inner tubes		
Auto ..... no.	30,776	55,163
Truck and bus ..... no.	37,214	157,209
Aircraft ..... no.	2,456	12,919
Other ..... no.	40,548	62,011
Solid tires		
Truck and commercial ..... lbs.	1,867	53,236
Tire repair material		
Camelback ..... lbs.	704,328	214,182
Other ..... lbs.	447,788	322,222
Tape, except medical and friction ..... lbs.	48,409	61,026
Belting		
V-type, vehicle, fan ..... lbs.	120,888	171,051
Transmission		
V-type ..... lbs.	113,376	228,902
Flat belts ..... lbs.	46,222	65,928
Conveyor and elevator ..... lbs.	259,143	291,022
Other ..... lbs.	659	1,239
Hose		
Molded and braided ..... lbs.	363,007	299,686
Wrapped and hand built ..... lbs.	151,458	149,127
Other hose and tubing ..... lbs.	91,314	113,197
Packing		
Sheet type ..... lbs.	63,558	38,422
Other ..... lbs.	175,804	235,357
Tiling and flooring ..... lbs.	359,138	109,595
Mats and matting ..... lbs.	436,859	149,361
Thread, bare ..... lbs.	28,109	43,983
Textile covered ..... lbs.	22,606	69,008
Compounded rubber for further manufacture ..... lbs.	583,091	256,563
Other rubber manufactures	.....	592,481
TOTALS	.....	$11,296,862
GRAND TOTALS, ALL RUBBER EXPORTS	.....	$14,327,869

Reexports of Foreign Merchandise

UNMANUFACTURED, LBS.		
Crude rubber	2,068,499	$469,353
Chicle and chewing gum bases	10,000	5,382
TOTALS	2,078,499	$474,735
MANUFACTURED		
Rubber soles, soling, toplift sheets ..... lbs.	6,342	$2,846
GRAND TOTALS, ALL RUBBER REEXPORTS	2,084,841	$477,581

Imports for Consumption of Crude and Manufactured Rubber

	December, 1953 Quantity	Value
UNMANUFACTURED, LBS.		
Crude rubber	86,864,756	$15,883,810
Latex	16,057,553	3,819,828
Balata	766,117	148,582
Jelutong or Pontianak	126,224	55,136
Gutta percha	134,524	33,175
Crude chicle	1,151,879	678,382
Synthetic rubber	2,319,197	615,292
Reclaimed rubber	570,636	36,804
Scrap rubber	2,203,498	104,092
TOTALS	110,194,384	$21,375,101
MANUFACTURED		
Rubber tires		
Auto, etc. ..... no.	1,955	$64,396
Bicycle ..... no.	11,488	9,022
Other ..... no.	12	211
Inner tubes		
Auto, etc. ..... no.	200	305
Footwear		
Boots ..... prs.	1,915	8,054
Shoes and overshoes ..... prs.	57,004	18,385
Rubber-soled canvas shoes ..... prs.	2,690	2,012
Athletic balls		
Golf ..... no.	54,720	15,475
Tennis ..... no.	1,200	218
Other ..... no.	160,098	25,313
Toys	.....	20,475
Hard rubber goods		
Combs ..... no.	23,676	2,255
Drug sundries	.....	823
Other	.....	32,288
Rubberized printing blankets ..... lbs.	280	396
Rubber and cotton packing ..... lbs.	9,267	15,203
Gasket and valve packing	.....	3,347
Molded insulators	.....	140
Belting ..... lbs.	27,071	24,146
Hose and tubing	.....	14,707
Gloves ..... prs.	47,880	18,247
Nipples and pacifiers ..... gr.	10,245	10,923
Instruments ..... doz.	9,982	6,948
Soles and heels ..... lbs.	6,606	1,054
Bands ..... lbs.	2,716	1,347
Other	.....	147
Gutta percha manufactures ..... lbs.	1,945	1,824
Synthetic rubber products	.....	958
Other soft rubber goods	.....	168,463
TOTALS	.....	$467,082
GRAND TOTALS, ALL RUBBER IMPORTS	.....	$21,842,183

SOURCE: Bureau of the Census, United States Department of Commerce, Washington, D. C.

Compounding Ingredients—Price Changes and Additions

Accelerator-Activators, Inorganic

Litharage, Eagle, sublimed ..... lb.	$0.16	/	$0.161
National Lead ..... lb.	.16	/	.161
Red lead, Eagle ..... lb.	.17		
National Lead ..... lb.	.17	/	.1725
White lead, basic Eagle and National Lead ..... lb.	.165	/	.175
White lead silicate, Eagle ..... lb.	.175	/	.1925
National Lead ..... lb.	.155	/	.165

Accelerator-Activators, Organic

Emersol 210 Elaine ..... lb.	.1375	/	.1725

Antioxidants

Sunolite #100 ..... lb.	.21	/	.23
#127 ..... lb.	.17	/	.19

Chemical Stabilizers

Eagle Basic Silicate White Lead 201 ..... lb.	.1825	/	.1925
202 ..... lb.	.175	/	.185

Plasticizers and Softeners

Harchemex ..... lb.	.25	/	.34

Synthetic Resins

Marvinol MX 3001 ..... lb.	.41	/	.57
Rigid vinyls ..... lb.	.69	/	1.38
VR-10, -20, -21 ..... lb.	.38	/	.54

Financial

(*Concluded from page 284*)

Monsanto Chemical Co., St. Louis, Mo., and subsidiaries, except British and Australian ones. For 1953: net income, $26,384,592, equal to $4.90 each on 5,270,051 common shares, contrasted with $23,189,243, or $4.29 a share, in 1952; net sales, $340,616,526 (a new high), against $266,704,442; income and excess profits taxes, $23,060,000, against $18,088,000; current assets, $137,262,528, current liabilities, $27,846,192, against $140,723,772 and $29,804,219, respectively, on December 31, 1952.

First quarter, 1954: net profit, $5,463,000, equal to $1.01 a share, against $5,814,223, or $1.08 a share, a year earlier.

Minnesota Mining & Mfg. Co., St. Paul, Minn., and domestic subsidiaries. For 1953: net earnings, $17,977,771, equal to $2.14 each on 8,218,985 shares, compared with $16,089,995, or $1.96 each on 8,025,856 shares, in the preceding year; sales, $219,916,383 (a record), against $185,241,760; income and excess profits taxes, $31,200,000, against $25,300,000; current assets, $96,525,119, current liabilities, $44,393,271, against $87,903,501 and $38,514,582, respectively, on December 31, 1952.

I. B. Kleinert Rubber Co., New York, N. Y. Year ended December 31, 1953: net earnings, $367,865, equal to $2.39 a common share, against $308,901, or $2 a share, in 1952.

Goodyear Tire & Rubber Co. of Canada, Ltd., New Toronto, Ont. For 1953: net earnings, $4,797,204, equal to $17.48 a common share, contrasted with $4,337,795, or $15.69 a share, in 1952.

The General Tire & Rubber Co., Akron, O. Quarter ended February 28, 1954: net profit, $1,851,515, against $1,509,786 in the corresponding period last year; net sales, $44,471,972, against $44,130,274.

Garlock Packing Co., Palmyra, N. Y. For 1953: net profit, $1,268,751, equal to $3.03 a common share, against $1,304,205, or $3.11 a share, in 1952.

Flintkote Co., New York, N. Y. Twelve weeks to March 27, 1954: net profit, $646,110, equal to 45¢ a common share, compared with $745,666, or 53¢ a share, a year earlier.

The Eagle-Picher Co., Cincinnati, O., and domestic subsidiaries. Quarter ended February 28, 1954: consolidated net income, $312,953, equal to 32¢ a share, compared with $632,698, or 64¢ a share, in the like period last year; net sales, $15,097,183, against $23,205,611.

Dow Chemical Co., Midland, Mich. Nine months to February 28, 1954: net earnings, $24,184,963, equal to $1.03 a common share, against $25,269,416, or $1.11 a share, in the same period of 1952.

Diamond Alkali Co., Cleveland, O. First quarter, 1954: net earnings, $1,329,698, equal to 53¢ each on 2,264,073 common shares, against $1,399,610, or 56¢ each on 2,262,503 shares, a year earlier; net sales, $22,184,991, against $21,572,915.

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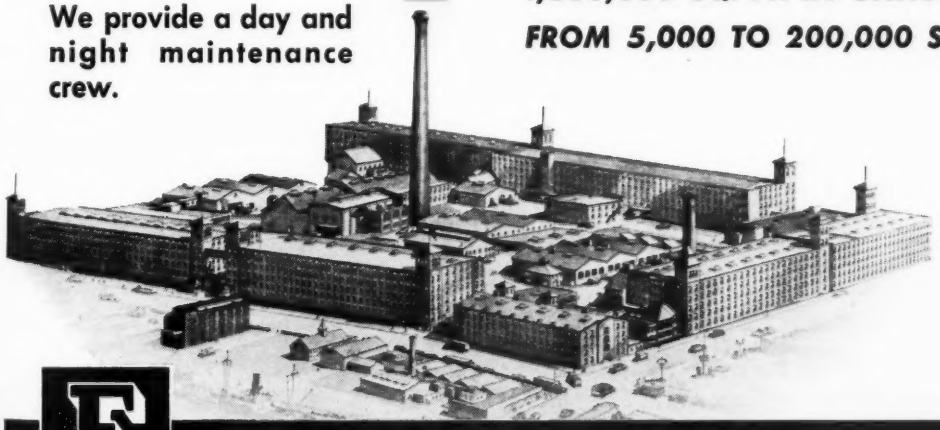

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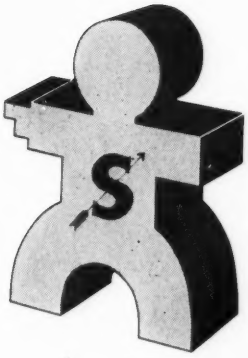

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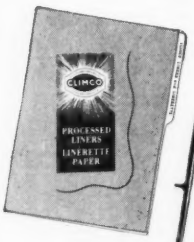

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